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PROMOTION OF THE MECHANIC ARTS.

MAY, 1851.

CIVIL ENGINEERING.

Extracts from the Annual Report of the Engineer of the Philadelphia Gas Works, made to the Trustees, January 10th, 1851.

QUANTITY OF GAS MANUFACTURED.

The extraordinary increase of demand for gas commencing in the month of November, 1849, immediately after the completion of the large street mains, has been maintained with but little abatement to the present time, the increase for several months being over 40 per cent., and the average increase of the entire year more than 34 per cent. In the summer months the increase upon the corresponding period of the year before, fell considerably below the average of the year, in consequence of the general adoption of an arrangement for the closing of stores at an early hour in the evening; but upon the return of the autumnal season of business, the demand again rose to its previous high ratio, and pressed so closely upon the means of supply, as to require the new sections of apparatus to be put at work as rapidly as they could be completed.

The quantity of gas manufactured during the year is, one hundred and eighty-two millions and sixteen thousand cubic feet, making the entire production of the Works since their foundation, nine hundred and ninety-seven millions eight hundred and fifty-nine thousand feet.

This product has been distributed in the following proportions to the various municipal districts supplied from the Works.

To the District of Spring Garden 17,650,600 cubic feet, to Southwark 3,457,800 cubic feet, to Moyamensing 417,900 cubic feet, to the City proper 160,489,700 cubic feet. The latter amount includes the gas used at the Works and offices of the Trustees, and the loss occasioned by leakage of mains and other apparatus.

The maximum production in 24 hours was eight hundred and eighty-seven thousand cubic feet, made on the 22d of December, and the maximum consumption in the same period was one million and twelve thousand* feet on the 23d of that month. The greatest number of retorts in action is 216, being within 24 of the whole number the buildings contain, and consequently leaving a margin for future increase of only nine per cent.

The materials used for the manufacture of gas are five hundred and ninety-eight thousand two hundred and eighty-four bushels of coals, thirty-two hundred and eighty-two barrels of rosin, five hundred and nine thousand five hundred and thirty-nine bushels of coke, and one hundred and eleven thousand six hundred and sixty-eight bushels of oyster-shell lime.

ECONOMIC VALUE OF PITTSBURG COAL.

The reduction of the motive power charge on bituminous coal coming through from Pittsburg, made by the Canal Commissioners in the tariff of tolls for 1850, which was announced in the last annual report, has had the effect then anticipated, of bringing into our market a large quantity of this valuable material, and accordingly more than half the year's supply has been derived from that quarter. In consequence of the superior richness in bitumen of this variety of coal, a gas of high illuminating power is obtained from it without the addition of any resinous material, the use of which has been discontinued since the regular introduction of the Pittsburg coal commenced in May last.

In respect to yield of gas, these coals are not quite so profitable as the best varieties obtained from other quarters, nor is the coke quite so lively and free burning; but notwithstanding these disadvantages, it will undoubtedly be consistent with good policy to continue the use of them in considerable quantity, so long as a supply can be secured at a moderate price.

DESCRIPTION OF THE WORKS.

The plot originally set apart for the Works comprised two rectangular blocks, bounded by public streets and the river front, and separated by a fifty feet street into nearly equal parts, each being 306 feet 6 inches by about 270 feet. By the erection of wharves on the Schuylkill river, the westernmost lot has been extended 170 feet westward to the Port Warden's line; and a farther addition of space has been acquired on the south by purchase and lease. The latter is separated from the original premises by the High street bridge and railroad, and is devoted to the storage of coals, pipes, and other materials; its dimensions are 500 feet by 200. The entire area occupied is about seven and a half acres, with a river front of 800 feet.

The buildings, constituting the Works, have been arranged in two general divisions or groups, distinguished in the books of the establish-

* A more definite notion of the magnitude of this volume of gas will be obtained by converting it into gallons, of which it will make seven and a half millions, or about the same as the daily consumption of hydrant water in the summer months.

ment as divisions A and B, but conveniently described as the old and new Works. Each division is composed of subordinate sections, numbered 1, 2, 3, 4 in the old, and 1 and 2 in the new group.

Every section is a complete and independent gas factory, capable of being worked unconnected with all the others as a separate and distinct establishment; but the whole are arranged symmetrically, and are susceptible of connexion, so that the gas produced in any section may be passed through the purifying apparatus and meter of any, at will.

The separate buildings comprise two retort houses, two purifying houses, two meter rooms containing six station meters and four conical governors, two ranges of workshops, and coke sheds and offices, three coal stores, two perpetual lime-kilns, and eleven gas-holders of various dimensions. (*See plate V.*)

The old Works, embracing all that was built prior to the year 1848, comprises four sections containing 120 retorts, built in two contiguous ranges or retort benches, covered by one roof and connected with one chimney stack. This retort house is 195 feet in length and 48 feet in width; it is built of brick, and rests upon arches supported by cast iron girders; giving space for the storage of 50,000 bushels of coals beneath the floor. The height of the chimney is 100 feet; the roof frame is of wrought iron covered with slate. The jet washers, condensers, and purifiers are contained in a two story brick building 87 feet long by 35 feet wide, situated on the north of the retort house, with which it is longitudinally parallel. The jet washers are eight in number, two attached to each section of thirty retorts; they are in the form of large columns upon square bases, all of cast iron; their dimensions are 40 inches diameter and 15 feet high, each pair being connected consecutively, so that all the gas from the section passes through both. Auxiliary to these, are two smaller jet washers, placed in close proximity to the hydraulic main. The condensers are composed of four separate series of vertical cast iron pipes 6 inches in diameter, standing upon boxes of the same material, of sufficient capacity to contain the condensed liquids of several days' work. The condensing surface for a section is 600 square feet, disposed in 18 of the upright pipes connected with 9 boxes. The purifiers are arranged in the usual quadruple series, connected by a rotating hydraulic valve. The boxes are 15 feet long by 5 feet wide, containing three tiers of cast iron baskets or gratings, upon which is placed a layer of quick lime two inches in thickness, giving 675 square feet area of purifying surface for each section, or 2700 feet for the entire range of 120 retorts.

The meters are four in number, having 6 inch outlets, and drums measuring 45 cubic feet to a revolution; the registry extending from ten to ten million cubic feet. Each meter is provided with a tell-tale and clock, and with water line and pressure gauges. These four meters are directly connected by a 10 inch receiving main with eight gas-holders of 50 feet diameter and 35,000 cubic feet capacity, from which the gas passes by two 10 inch outlet mains into two 10 inch governors attached to the street main. Since the construction of the new Works, two transverse mains of eight inches diameter have been led off from these meter outlets to those of the new meters, forming the connexion between each division and the gas-holders of the other.

The range of offices, meter-room, and fitting shop belonging to this division, is 133 feet by 20, the coke shed 170 × 24, and the coal shed 80 × 50, arranged around a hollow square.

The new Works differ from the old in several respects. They are divided into two sections with 8 inch connexions; the purifiers give more surface for the same number of retorts, and the general arrangement is more convenient and gives greater security from accidental obstructions.

The retort house is of the same length as the other, but 4 feet wider, being 195 × 52; externally it corresponds with the other in style of architecture, and is roofed in the same manner; the number of retorts is the same, to wit, 120. The auxiliary washers are much larger, being 24 inches diameter; the principal washers are similar to those in the old house, being eight in number. The condensers are arranged in double series, four pipes standing on one box; the surface for 120 retorts is 2400 feet.

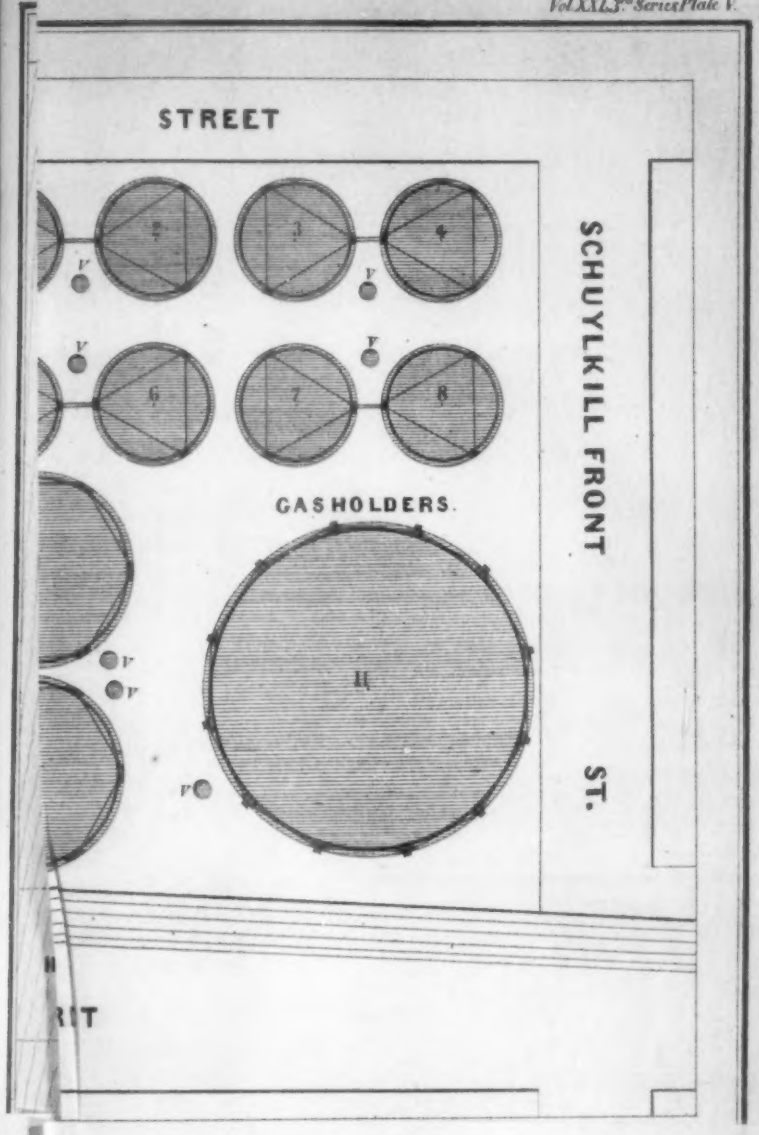
The purifying boxes are eight in number, 15 feet square, giving 4050 square feet of purifying surface for the two sections. They are supported on brick piers entirely independent of the floor, and elevated so as to allow plenty of light and air to the connecting pipes and drips in the cellar below. The building in which these are placed is 91 feet by 47; it is roofed with slate, as are all the buildings on the premises. There are but two meters to this division, having 8 inch outlets, and drums giving 163 cubic feet to a revolution. Two 10 inch mains connect them with the three largest gas-holders, from which two 12 inch mains return to the conical governors in this meter room.

The gas-holders immediately connected with the new division, are two of 80 feet diameter containing 200,000 cubic feet each, and one of 140 feet diameter, with a capacity of one million of cubic feet, all of the telescope form. The old Works communicate with these through the two 8 inch mains before described. The guide frames of these gas-holders are entirely of cast iron; those of the 80 feet holders are composed of six stands of fluted columns arranged in pairs, with an entablature to each pair, and raised to three tiers in height, there being 36 columns to each gas-holder, the whole bound together at the top by cast iron open work girders. The large gas-holder is guided by twelve sets of columns standing in groups of three raised 4 tiers high; the lower tier fashioned and proportioned according to the Tuscan order, the second Doric, the third Ionic, and the upper Corinthian; the number of columns being 144, and the whole height of the structure, above the coping of the tank, 74 feet; the depth of the tank is 36 feet.

The extent of the range of offices, smith shop, and meter house of the new division is 122 × 20, the coke shed, store rooms, &c., 270 × 22 feet.

The southern coal store is constructed in four sections 100 feet long by 30 feet wide, joined side by side, so that they constitute one building 100 × 120 feet, with the roof supported on five ranges of stone piers 18 feet high: its capacity is about 200,000 bushels.

Between the retort houses is an underground coal store, 40 × 190 feet, capable of storing 40,000 bushels.


STREET
SCHUYLKILL FRONT
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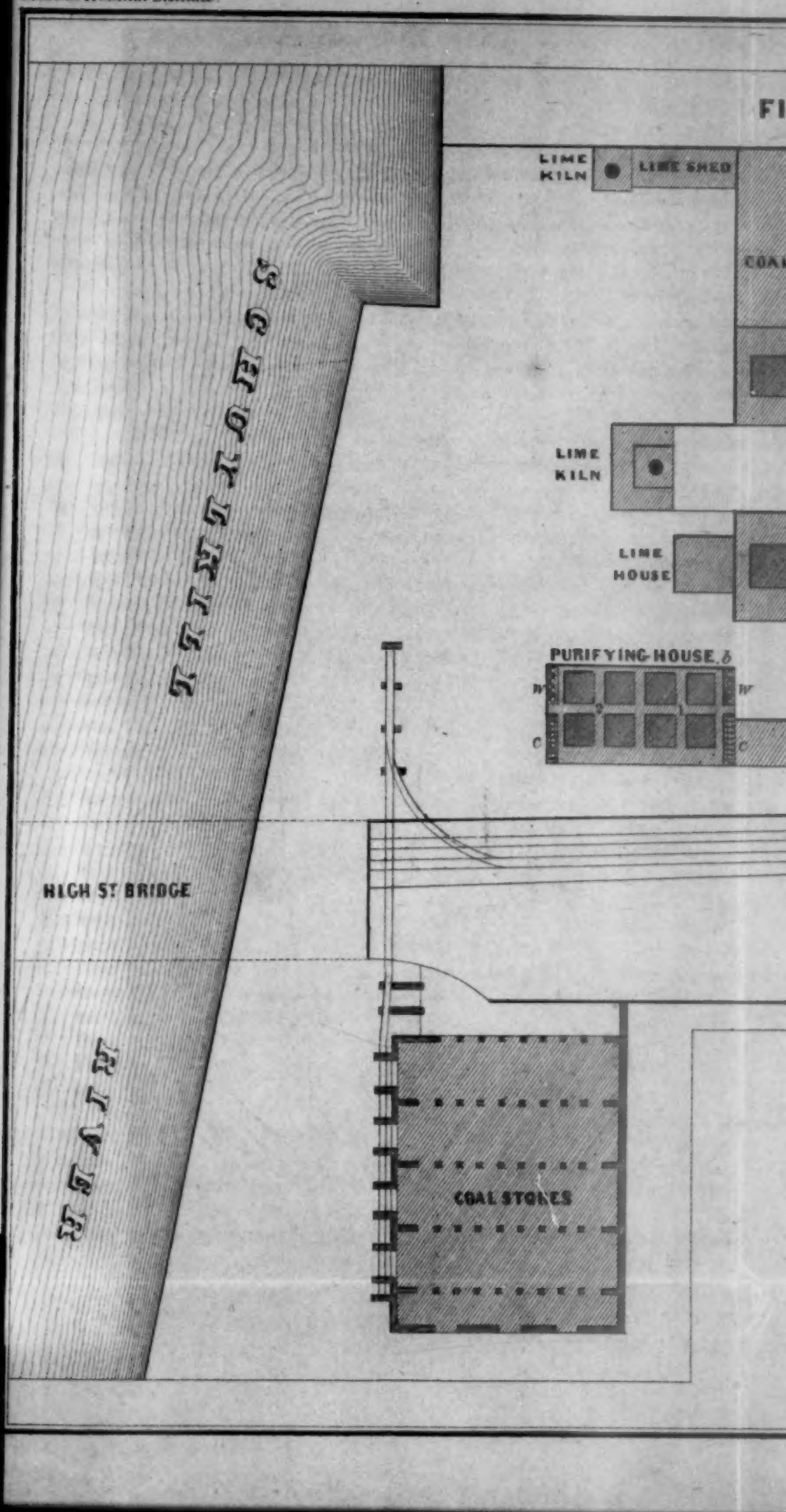
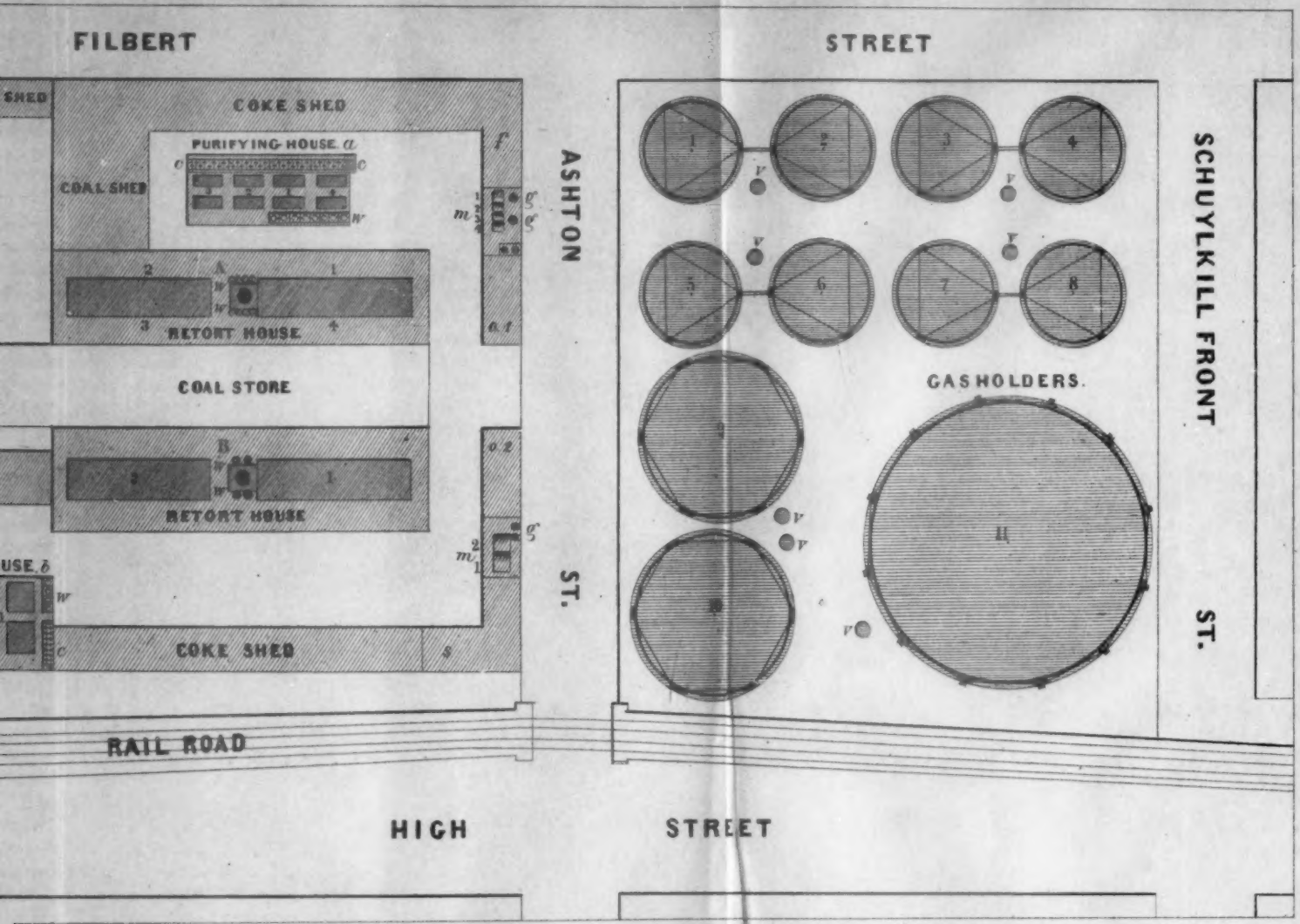

LIME KILN
LIME SHED
LIME KILN
LIME HOUSE
PURIFYING HOUSE.
SCHUYLKILL
HIGH ST. BRIDGE
RIVER
COAL STORES



Ground Plan
of the
PHILADELPHIA GAS WORKS

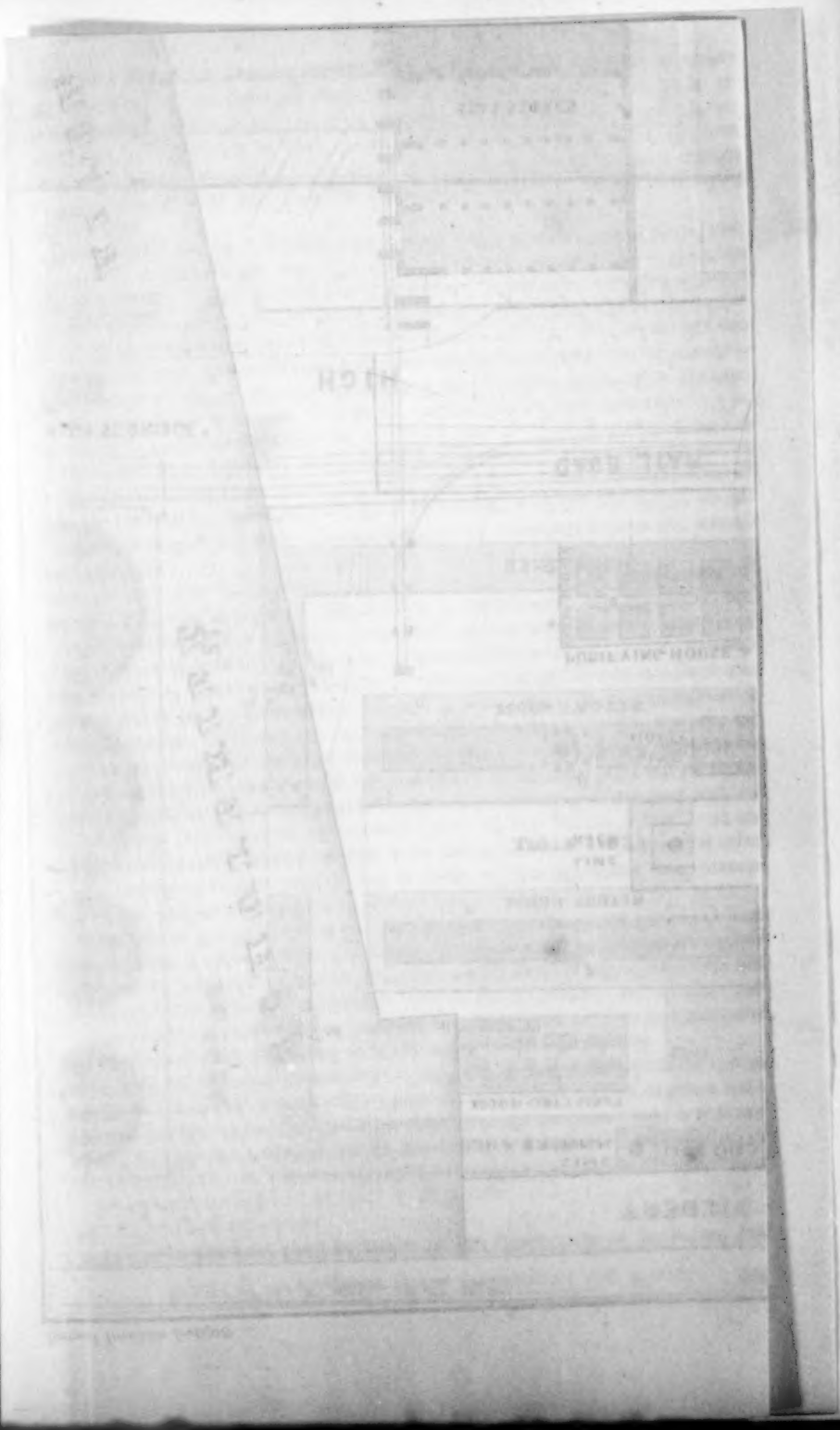
Scale 80 ft. to 1 inch.

REFERENCES.

c	Condensers	o 1	Sales Office
f	Fitting Shop	o 2	Engineer's office
g	Governors	s	Smith Shop
m	Meters	v	Valve houses
w	washers		

John C. Cresson, ENGINEER.

Friend & Aub. Lith.



The lime kilns are built of stone in the usual form of perpetual kilns for calcining oyster-shells.

In constructing the more recent buildings, they have been adapted as far as practicable to the use of labor-saving machinery for the storage of coals, and for the conveyance of these and other heavy materials to the various points where they may be wanted. The railways and machinery for these purposes, it is designed to construct in the course of the current year, and an important reduction of the labor and expense required for these operations is expected to result from the improvement.

The progressive growth of the establishment in its various departments, is exhibited in several condensed statements arranged in tabular form. The usual monthly details of new customers and increase of lights and mains, and of sales of gas, are given in tables A to E, inclusive. Those marked from F to I, exhibit the aggregates of these items for every year since the establishment of the Works.

In concluding this descriptive account of the Works, a few remarks upon some of the causes to which their uninterrupted prosperity and rapid growth are in a measure attributable, may not be out of place. At the commencement of the enterprise, it was determined that the construction of the Works and the system of management should be such as might lead to the greatest attainable security against the dangers and annoyances then generally supposed to be necessarily attendant on the use of gas lights, the most frequent origin of which was either in defectiveness in the apparatus and pipes, imperfect purification of the gas, or irregularities of quality and supply. A system of regulations was adopted at an early period, prescribing with great exactitude the materials, sizes, manner of connecting, and degree of tightness of all pipes and other fittings, and strictly prohibiting any unauthorized interference with, or disturbance of, such fittings.

The most efficient and unfailing means of separating from the gas its known impurities, are required to be carefully applied according to the indications of delicate chemical tests. A high standard of illuminating quality has been adopted and vigilantly maintained, either by the use of the proper varieties of coals, or by the addition of a proportion of gas from resin when the coals had fallen below the proper standard. The quality aimed at is that found in gas having, when purified, a specific gravity one-half that of atmospheric air, the economical value of which is such as is designated 20 candle gas, that is to say, the light of an argand burner consuming 4 feet an hour, is equal to that of 20 sperm. candles, six to a pound. The desired result as to quality has been attained without the aid of resin, by the use of certain varieties of coals from Western Pennsylvania, or of a proper mixture of cannel with New Castle and other coals.

The success with which these measures have been carried into effect is forcibly demonstrated by the entire freedom of our streets and houses from the peculiar odor of gas, by the remarkable diminution of the loss from leakage usually experienced, amounting in some works to 20 and 30 per cent. of the quantity made, but falling as low as 2 per cent. in ours, and finally the general introduction of gas lighting not only in stores

and places of public resort, but also in the parlors and sleeping apartments of dwellings of every class.

INCREASE OF CONSUMATION OF GAS.

For several years there has appeared to be good reason for the supposition that the ratio of increase was near its eventual maximum, and must thenceforward decline until it should reach a moderate average, which might be maintained for a number of years without any important variation. But these expectations have been annually exceeded by the result, and the year just closed has surpassed all that have preceded it, not only in the actual amount of the increase, but also in its ratio or per centage above the previous year. Part of this great increase is undoubtedly attributable to the additional head of supply afforded by the large mains completed in the autumn of 1849; but the continuance of a high ratio of increase in the months of November and December, when the comparison was no longer affected by this circumstance, is an indication which it may not be entirely safe to overlook in our estimate for the incoming year.

The District of Spring Garden is engaged in the construction of Works from which their own supply will be obtained as soon as they are put in operation, which is expected to take place in a few months, and the City Works will consequently be relieved to the extent of the consumption of that district, amounting to nine per cent. of the whole production. If we adopt as the supposed increase in the city and districts the ratio maintained in November and December and the first ten days of January, inst., and deduct therefrom the proportion furnished to Spring Garden, there will remain an increase of 16 per cent. to be provided for in the present year.

For one-half of this increase, the Works now existing may safely be relied upon, and if the increase could with certainty be limited to a maximum of 16 per cent., it might be practicable to push them for a brief period to that extent.

On the Improvement of the Construction of Railway Carrying Stock.—By Mr. W. A. ADAMS, *of Birmingham.**

In the paper laid before the last meeting of the Institution,† the great increase that has gradually been made in the dead weight of railway carrying stock was pointed out; the first class carriages, carrying 18 passengers, having been increased, in dead weight, from 3¼ tons to 5 tons; and the wagons, carrying a maximum load of 5 tons, having reached a dead weight of 4¾ tons; whereby an important addition was simultaneously made to the cost of locomotive power for the nett load carried.

The great increase in dead weight has arisen from the gradual increase in the quantity and weight of material employed in the construction of railway carriages and wagons, as a remedy for the failure of their different

* From the London Journal of Arts and Sciences, for March, 1851.

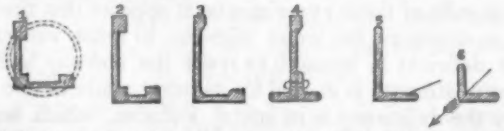
† See Journal Franklin Institute, page 153.

parts; and that without alteration of material or the construction of parts. The reduction of the dead weight of railway vehicles is extremely desirable, while such reduction of weight is effected with due regard to efficiency and strength to resist the longitudinal strain in buffing, as well as the other strains to which they are subjected. The object is to produce such vehicles as shall be, all points considered, the most economical in first cost, in maintenance, and especially in traction; but it does not follow that reducing the dead weight, and improving the quality of materials, will add materially, if any, to the cost.

The *sole-bar* is the most important part of the wagon under-frame, as it resists the main force to which the wagon is subjected, namely, the longitudinal buffing, and also acts as a girder to carry the load upon the springs. The ordinary wood sole-bar averages from 10 to 12 inches deep, and $3\frac{1}{2}$ to 5 inches thick. Although the principal strain is the end-way buffing, the vertical strength is required to be so much greater than the lateral strength, in consequence of the sole-bar being strutted horizontally by the internal framing.

The author has endeavored to discover the best form to attain the same strength in wrought iron with the least material, and thereby ascertain whether the same strength can be attained with less weight than the ordinary wood sole-bar.

The average dimensions of the ordinary English oak sole-bar are 11 inches deep, $4\frac{1}{2}$ inches thick, and 13 feet long; the total weight, in actual practice, is 321 lbs. The correct theoretical section for wrought iron, to answer the same purpose with the least material, would appear to be a box-girder, of similar shape to the oak sole-bar. But this cannot be practically adopted, as it would be next to impossible to manufacture; and it is necessary that some practical form of rolled iron be adopted, for economy and simplicity of construction. The main force to be resisted is the end-way buffing; and, as the strongest form to resist end pressure with the least material would be a tube, (as shewn by dots in fig. 1,) that



section which imitates a tube the nearest will be the correct form. The strength of the tube arises from the metal being distributed at the greatest distance from the centre: therefore, in the section, fig. 1, the metal has been principally distributed in three points of the circumference of the circle, which points are connected by the thin sides of the iron. But, inasmuch as the vertical strength is required to be considerably greater than the lateral strength, this theoretical section requires altering to the proportion shewn at fig. 2. The practical section proposed to be adopted on this principle is shewn at fig. 3, the height being 7 inches, and the width 4 inches; the sides being as thin as practicable, and the metal being thrown into the extremities. The thickness of the sides is, therefore, $\frac{5}{16}$ inch, and the extremities $\frac{7}{8}$ inch. The weight of this section (13 feet in length,) is 219 lbs., being nearly one-third less than the ordinary oak sole-bar, which weighs 321 lbs.

The following experiments were tried, to ascertain the requisite strength of iron to be employed for this purpose.

An English oak sole-bar, 10 feet long, of the common sectional form, of picked quality, and straight-grained, was subjected to end-way pressure in a hydraulic press—being supported only at the two ends.

15 tons, deflected it $\frac{1}{4}$ inch at the centre.
22½ " " ½ " "
30 " " ¾ " "
35 " " when it broke.

The breaking did not appear to be caused by deflexion, but by the crushing and lateral separation of the fibres; the principal fracture being several feet in length, and extending from side to side on the edgeway of the timber.

A wrought iron bar, of the Great Western section, shewn at fig. 4, and the same length, (10 feet,) was fixed in the press in the same manner.

15 tons, deflexion none.
19 tons deflected it ¼ inch, without set.
22½ " " 4 inches, permanent set 2¾ inches.

The deflexion was entirely lateral, and towards the side of the larger flanch. This bar is made of two pieces, riveted together, one 7 inches high and ½ inch thick, with a small flanch on one side, and an angle iron, 3 inches wide, is riveted to it on the opposite side.

To ascertain the comparative vertical strength, an English oak sole-bar was placed edgeways on two supports, 6 feet apart, and the force of the press applied in the centre.

10 tons deflected it ½ inch,
12 " " ¾ inch.
16 " " broke it.

The wrought-iron bar of fig. 4, section, was tried in the same manner, with the force applied on the edge, and supported on the flanch.

10 tons deflected it ½ inch.
12 " " ¾ " permanent set ⅛ inch.

From the results of these experiments, it appears that the iron bar, fig. 4, is about as strong as the wood sole-bar, to resist vertical force, but is somewhat deficient in strength to resist the endway buffing. In this section a loss of strength is caused by its being made in two pieces riveted together: the deficiency is in lateral stiffness, which would be considerably increased if it were all one solid bar of iron. It appears from the following experiment that the deflexion would be on the *opposite side* to the large flanch, if the whole were solid.

A bar 7½ feet long, of the section, fig. 5, was subjected to endway pressure in the same manner as before: the depth was 6 inches, the width 3½ inches, and thickness ⅝ inch.

23 tons produced no permanent set.
26 tons produced a permanent set of 1¾ inch laterally, and 1½ inch vertically,

the deflexion being on the *opposite side* to the flanch.

Also a bar 5½ feet long, of the section, fig. 6, was tried in the same manner by end pressure: the depth and width were both 3 inches, and the thickness ⅜ inch.

9 tons produced a permanent set of 1 inch, both laterally and vertically the same,

the deflection being in the *opposite direction* to the flanches, and diagonally as shown by the arrow, from the depth and width being equal.

From these results, it appears that the two edges of the bar yielded to the pressure more than the rest of the section, and allowed the bar to bend outwards. These edges are consequently strengthened in the proposed section, fig. 3, by increasing the thickness, which will diminish the deflexion, and enable the bar to resist a greater endway strain without permanent set.

An important circumstance in the comparison of strength between wrought iron and wood is, that with iron the full experimental strength is obtained in practice, but in wood the strength obtained in practice is considerably less than that shown by experiment, on account of the defects to which timber is liable and the mortices and bolt holes cut into it.

The author stated that he was about to have a quantity of iron rolled to the proposed section, fig. 3, for the purpose of constructing certain wagons, and hoped to be enabled, previous to the next meeting, to give the results of actual trial.

A very important advantage would be obtained by the use of iron from its greater durability. English oak, admitted to be the best material, cannot be procured in a thoroughly seasoned state in any large quantities, and is consequently, after it is made up, in a transition state for a term of years. The timber opens and shrinks, and the joints loosen, admitting wet and accelerating decay.

But, presuming that an efficient wagon frame be practicable from iron, it is difficult to place a limit upon the period of its duration, if well preserved from oxidation by paint or tar.

It should be noted that the English oak, weighing 72 lbs. per cubic foot, is in the unseasoned state in which it is generally used for wagons; and that as it seasons in work it lessens considerably in weight, but at the same time loses in strength.

The author had not been enabled to carry out his investigation into the application of iron to railway vehicles, further than as respects the principal portions of the underframe, but proposes to continue the subject practically before the next meeting.

Mr. T. Thorneycroft observed, that he had witnessed some of the experiments that were described in Mr. Adams' paper, and could testify to the accuracy with which they were performed.

It was suggested that it would be difficult to roll a bar of iron of the proposed section, fig. 3; and a proposition was made that it should be rolled with the ends flattened out a little, and that they should be closed in at the last time of passing through the rolls.

Mr. Slate remarked, that the author's deductions appeared to lead him to the conclusion that the hollow rectangular section was the best form, provided the iron could be rolled into that shape; but he diverged into the L-form, because it was the only practicable shape. He thought there would be no difficulty about rolling the rectangular section, but there would be some difficulty about the other; if it were sufficient for the purpose of fixing the cross framing, it could be rolled out as easily as a tube, and, with the aid of another mandril, might be flattened into any rectangular shape desired, which would probably be less expensive than rolling the L section.

Mr. Cowper remarked, that the cost of rolling the proposed L section, fig. 3, might not be more than £2 per ton extra upon bar iron.

Mr. Allan inquired how the Great Western plan was found to answer; for they had some hundred wagons running, made with the frame of the section, fig. 4.

Mr. Barrans suggested the adoption of the rectangular section, with wood blocks filled in where required, and bolted through to give strength to the frame. He asked if it could not be rolled in two parts and riveted together afterwards.

Mr. Adams replied, that would bring them to an increase in cost per ton, and the expense was an important matter to be taken into consideration. It was desirable to get a square side and bottom for attaching the spring-shoes, with the cross-bearers merely riveted through; and he thought a mitre-joint at the corners of the frame would be necessary, and that the proposed L section was the most convenient for all these purposes.

Mr. Wright said that, in considering the increase in weight of railway carriages, it must be borne in mind that the public had demanded increase of strength and room, as essential to comfort and security, more especially in rapid traveling. He thought the comparison between the common road-coach and the railway carriage would not hold; because not only did they go at a very limited speed, but they were provided by contractors, who, for the sake of their horses, had the vehicles as light as possible; and it must be remembered there was no danger arising from collisions; there was no buffing, but only traction. The uniform requirement of the public had been for an increase of strength in the railway plant; and they had abundant proof that the original carriages with open frames had not been strong enough to bear concussion; for in collisions, such carriages received all the damage; whilst the modern strong-built carriages escaped uninjured. According to the views of the writer of the paper, in increasing the weight of carriages, as a necessary consequence of increased size and strength, they had been going back instead of forward; but he was not of that opinion; on the contrary, he thought they were decidedly improving in construction. He could not imagine that the iron sole-bar proposed, would be so strong as the wood; and he thought good seasoned oak timber would be found preferable for the purpose.

Mr. Adams observed, that the original carriages had not been found strong enough for the duties they had to perform; but he considered that, in increasing their strength, the dead weight had been too much increased, from the want of scientific principles in the construction.

Mr. Cowper remarked, that the observations of the paper were directed to find out the best kind of frame, and to discover the mode of making a good frame as light as possible, consistent with strength and durability. He thought that the proposed section promised a good result; and he could speak practically on the subject, because he had made a great number of experiments on the end thrust of L and T-iron for iron roofs: he had found that, when the edges of the flanch were thin, the iron was defective in strength to resist an endway thrust. The metal at a distance from the general centre of the section was most advantageously placed

for strength; and in the section, fig. 3, the metal was distributed as far as possible from the centre, thereby securing the full advantages obtained by the depth.

Mr. Slate conceived it a matter of the highest importance to diminish dead weight; and that great improvements had yet to be effected in that particular; certainly, if they had now 5 tons of dead weight where they had formerly 3¼ tons, they had not much improved; for they had thereby increased the cost of traction one-half. He did not know of any instance where there was so large a proportion of dead weight in any kind of machinery as there was in railway rolling stock; and the dividends on railway property must be diminished by it. It was surprising that, on a road possessing such perfection and advantages, they should have such an enormous proportion of dead weight; in an abstract sense, it rendered the new railways less perfect than the old roads, where the proportion of dead weight was so much less.

Mr. Wright thought it ought to be observed, that railway-carriages had been much increased in their size, to suit the convenience and comfort of travelers. Originally, they were 15 feet long, 6 feet 6 inches wide, and 4 feet 9 inches high; but now they were from 18 to 20 feet in length, 7 feet wide, and 5 feet 6 inches high. The increase in size was of course one element in the increase of weight. Originally, in the case of the axle-journals, they were $4\frac{1}{2}$ by $2\frac{3}{8}$ inches; but they had soon increased to 5 by $2\frac{5}{8}$ inches, and were now much larger; also, the wheels were originally 17 cwt.; but now they weighed from 25 cwt. to 27 cwt. These had to do the same business; the number of passengers were not increased, but the vehicles to carry them were heavier.

Mr. Henson was of opinion that, before long, the dead weight would be reduced one-third, while the weight carried was increased one-third; and that the cost would be also diminished. He was engaged in the consideration of the subject, and would be glad to bring the results before the Institution at a future meeting.—*Proc. Inst. Mech. Eng.*

On the History and Construction of the Britannia Bridge. By Mr. Geo. Grove, *Secretary.* *

It was originally intended that the Chester and Holyhead Railway should cross the Menai Straits by Telford's well known suspension bridge; but this plan was abandoned on account of engineering difficulties; and the site occupied by the present bridge was fixed on. It takes its name from the Britannia Rock, lying in mid-channel; on which its centre pier is founded. At this place, Mr. R. Stephenson proposed to build a bridge of two cast-iron arches, each of 350 feet span and 100 feet in height, which were to be erected without the use of centres, by continued additions to the spandrils, each piece being connected to its fellow on the opposite side of the pier by tie-rods. An end was put to this design by the requirement of the Admiralty, that the same height should be preserved at the springing of the arch as at the crown; in other words, that its under side should be a straight line.

* From the London Journal of Arts and Sciences, for March, 1851.

In this position of affairs, the conception of a tube occurred to Mr. Stephenson; and to determine its shape and the details of its construction, he was empowered by the directors of the line to make a magnificent series of experiments, which were conducted at the works, and under the care of Mr. Wm. Fairbairn, at Millwall. The first series of experiments was on 34 tubes, of three different sections, round, oval, and square or rectangular, varying in length from 18 to 27 feet, and in diameter from 9 to 18 inches. They were, in all cases, supported at their ends, the testing weight being hung at the middle, till fracture took place. The rectangular form was found to be much the strongest: it was the only one in which failure did not take place in the upper side.

When a beam, supported at its ends, is loaded at the middle, the fibres of the top, or upper side, are compressed; while those of the bottom are stretched. When, therefore, a beam of uniform shape is broken by the failure of the top, it is evident that the strength of the material to resist compression is not equal to that with which it resists tension; and the reverse. The power of cast-iron to resist compression is to its power of resisting tension as 5 to 1; while, by these experiments, it was discovered that in wrought iron the proportion is reversed, its power to resist compression being to its power to resist tension as 9 to 11.

The second series was on a model tube, one-sixth of the dimensions assumed for the real bridge, 75 feet long, 4 feet high, 2 feet 9 inches wide. The sides and bottom were of single plate; but the top contained six cells, or flues, running from end to end. Six experiments were made with this model, to determine the proper proportion to be kept between the material of the top and of the bottom. In the last experiment, the tube broke with 86 tons suspended—equal to 172 tons distributed over its length—the sectional area of the top being 26½ inches, and that of the bottom 22½, or as 11 to 9 very nearly.

During these experiments, the masonry of the bridge was proceeding rapidly.

The Britannia Rock is in mid-channel; and upon it is the tower called by its name, which, at its base, is 60 feet by 50 feet 5 inches. Its entire height is 221 feet 3 inches. It is not of solid masonry; but contains a centre wall, dividing it into two wells, which are arched over under the tubes at a height of 97 feet from the base. The sides are tapered, so that at the level of the bottom of the tubes it is 51 feet 4 inches by 45 feet 5 inches.

At a distance of 460 feet on each side of the Britannia Tower stand the two land towers on the Carnarvon and Anglesey shores. At their base they are 60 feet by 37 feet; and at the level of the tubes 51 feet 4 inches by 32 feet.

From the land towers to the face of the abutments, which stand still further inland, is a space of 230 feet. The abutments themselves are in all 176 feet long. Each entrance is guarded by a pair of gigantic lions, carved in limestone, from the design of Mr. Thomas. The external parts of the masonry are of "Anglesey marble:" a hard mountain-limestone, full of fossils, extremely durable, and with an appearance of great solidity. This stone is backed in with Runcorn red sandstone, and with brick-work in cement.

A large number of cast iron girders were built in to the solid stonework, for the purpose of effectually distributing the pressures of the enormous weights which were carried by certain spots during the lifting of the tube. Of these, the Britannia Tower contains no less a weight than 394 tons—the total weight in the towers and abutments being 929 tons.

The scaffolding employed was constructed on the modern plan, with whole balks of very large timber.

The dimensions of the tubes having been definitely fixed, it was determined to build the four large ones on platforms or jetties, lying along the high-water mark of the Carnarvon shore; then to float them to the foot of the towers; and finally raise them to their places by hydraulic power. The land-tubes were to be built in their places on scaffolding.

Supposing one of the large tubes to be completed, and lying ready to be floated on the platform;—it is 472 feet long,—3 feet higher at the end which is to enter the Britannia Tower than at the other, which is 27 feet high. It has eight cells in the top, and six in the bottom; in both cases 1 foot 9 inches high, but of different widths. The platforms, forming the upper and lower sides of the top cells, are of single thickness; and they are connected with the upright plates of the cells by two angle-irons, matched on the opposite side of the plate by a flat strip. These junctions are formed by rivets, which are inserted at a red heat, and, while hot, are closed up—exerting, by their contraction, a great power on the plates through which they pass. The riveting of the lower part of the top cells is performed with ease before the top platform is put on; but, to accomplish the riveting of the latter, it is necessary that the "holder up" (the man who keeps the rivet in its place whilst its head is being beaten up) and his boy should be inside the cells; which they are for hours together. While in this position the rivets are supplied to them through small holes, left for that purpose.

The plates, forming the sides, run vertically; and they are joined together by double T-irons, which form a pillar of great strength at every two feet distance throughout the tubes. These T-irons are bent round at right angles, and riveted to the platform of the top and bottom; and a triangular plate, called a gusset, is used to fill the corners with great effect, against the twisting strain exerted by the wind. The platforms of the bottom cells are of double thickness of plates, arranged so as to break joint; the covers (plates riveted over the joints) being large and strong; the whole forming, in fact, a *chain* to resist tension; while the top is constructed with small covers and nicely-executed joints, so as to act as a *pillar* to resist compression. The sectional area of the "top" of the tube, at the Britannia Tower, is 648, that of the "bottom," 585 square inches.

Cast iron frames, of great strength, are fitted into each end of the tubes, and into the lower set of cells, to resist the great crushing or "shearing" strain occurring at the points of support in the towers. To these frames are fitted the iron beams to which the lifting chains are subsequently attached, and which consist of three very strong cast-iron girders, accurately fitted, having pillars of iron jammed between them, and a strap of wrought-iron passing completely round them, so as to make them all into one solid mass.

The tubes having been completed on the platforms, it was necessary that they should be cut away, that room might be made for the pontoons, by which the work of transport was to be done. Temporary stone towers were therefore built under each end, and a packing of elm planks inserted to receive the pressure of the tube. The platforms had been built with an upward curve of 9 inches; and it was found that, after they were cut away, and the tube took its own bearing, the deflexion only slightly exceeded this.

The rocky beach, beneath the tubes, was next excavated to admit the pontoons. These were eight in number—six of wood, 100 feet in length, 25 feet wide, and 10 feet deep; and two of iron, of the same length, but 31 feet wide, and 8 feet 9 inches deep. They were arranged before the tube in two groups, and were divided by partitions, or bulkheads, into several compartments, each having a valve, that could be shut or opened by screws on deck, and by which any amount of water could be admitted to diminish or wholly destroy the buoyancy: they were also provided with pumps for removing this water, or any that might leak in. By keeping these valves open, the pontoons remained perfectly still below the tube till the time came for floating.

The principle on which it was determined to conduct the floating of the first tube was, that the tube should be hauled out into the flowing or rising tide, which runs in the required direction, when the velocity of the tide was such as to bring the tube to the foot of the piers just at the time of high water; the ends of the tube being brought over stone shelves, prepared at the bases of the towers, on which, as the tide descended, it would be left resting. Thus, the tide itself was made to do the work of transport, and no exertion would be wanted, except for the purpose of pilotage.

The difficulties which had to be guarded against were enormous. A mass of 2000 tons in weight, and of the most cumbrous awkward shape imaginable, had to be navigated in a tideway where the current is often eight miles per hour, with the risk of a capricious wind springing up (as in every mountainous country they unexpectedly do,) which would act with fearful effect on the huge sail-surface of the tube; this unwieldy mass had to be turned half round on its passage, and guided safely past the points of the Britannia Rock; and, lastly, there was the absolute impossibility of making any change in the arrangements as unforeseen emergencies might occur.

Two 12-inch ropes were laid down the stream from a sunk mooring, opposite the farthest tube, to two capstans on the other side of the Anglesey land-tower; and on them the tube was to travel, as a ferry-boat, on its guide-lines. They ran over the pontoons, where they passed through cable-stoppers, or contrivances by which the rope could, on occasion, be gripped so hard as to stop the motion of the whole mass. These guide-lines were buoyed up by casks, attached at intervals, to protect them from the sharp rocks of the bottom. Two 8-inch lines, leading from moorings on the opposite shore to capstans on the shores and on the Britannia Rock, were to effect the last delicate operation of placing the tube in its ultimate position.

The capstans were fully manned by 11 superintendents, 450 laborers, 65 sailors, and 12 carpenters. Each capstan had 48 men; each set of pontoons carried 105 hands; and 6 boats, with spare line, attended the tube in its outward progress. The capstans were signalled-to from the tube by holding up the distinguished letter of the capstan and a flag, the color and position of which indicated what was required.

On the evening of the 20th of June, the floating took place. The pontoons, having been rendered buoyant by the closing of the valves, rose with the tide until they reached the bottom of the tube, which was lifted clear off the temporary piers at half-past seven. The land attachments being cast off, and the capstans of the hauling-out lines set in motion, the mass swung out into the stream at a rapid pace. When the proper distance from shore had been reached, a chain, made fast to the back of the tube, was cast off, and the onward progress began. By means of the cable-stoppers, which acted admirably, the speed was kept at about 1½ mile per hour. When about three-quarters of the journey had been performed, and the tube had begun to take a position close to the Britannia Rock, and oblique to the course of the tide, a delay arose, owing to an accident at the "Llanfair Capstan," on the Anglesey shore, where the coils of the rope over-rode one another, and prevented the motion of the capstan; as the tube, therefore, floated on, it dragged the capstan from its frame; and, but for the superintendent of the capstan inducing the crowd of lookers-on to take hold of the long end of the rope, and by the weight of hundreds prevent its further slipping, there is much cause to fear that the pontoons would have grounded on the Britannia Rock, and the whole have been wrecked.

The key to the concluding steps of the floating was a pile of timber and stonework, beyond, but close to, the Anglesey land-tower, called the "Anglesey Butt:" against this, as a pivot, the tube was to bear while being veered across the opening, at right angles to the line of the current. Up to this it was hauled by a powerful crab behind the Butt; after which, the delicate operations necessary for inserting the high end into the recess in the Britannia Tower (only two inches wider than the tube in its oblique position) were performed by the two capstans and the large crab on the Britannia Rock. The tube having been hauled home at the Britannia Tower, it only remained to bring it into the open recess in the land tower, which was done at twenty-two minutes after nine, when the welcome "All right!" of Mr. Stephenson was the signal for loud and prolonged cheering and firing of cannon. As the tide ebbed, the pontoons floated away from below, leaving the tube to span the opening with no real or imaginary assistance.

The tube having reached its destination at the foot of the piers, the next operation was to lift it through the 100 feet between that position and its ultimate place. This was done by hydraulic presses of enormous dimensions; that at the Anglesey end having a ram of 20 inches diameter, and a cylinder 10 inches thick; and that at the Britannia end, two cylinders, with rams 18 inches diameter. The ram carried a cross-head of prodigious strength, of cast iron, strengthened on the top side by wrought iron links, put on hot; from it depended the lifting-chains, the lower ends of which were secured to the beams in the end of the tube. The "stroke"

of the press, or the height of which it was capable of lifting through, was six feet, and each link of the lifting-chains corresponded in length. These were formed like those of a suspension bridge, alternately of eight or nine bars. On the upper part of the frame of the press, 12 feet below the top of the cross-head when at the highest point of its lift, was an arrangement of "clams," which were blocks of iron, planed accurately to fit the square shoulders of the head of the chain: by screws and gearing these clams could be opened or closed, so as to let the chain pass, or to embrace and hold it firmly. On the cross-head was a precisely similar arrangement. When, therefore, the press had completed its lift of six feet, the head of the third link had just reached the level of the clams. These being brought in under the shoulders of the link, transferred to themselves the weight of the dependent tube. The clams on the cross-heads were then opened, the ram lowered, the top link taken off, the cross-head clams closed, and the bottom clams opened, when all was ready for another lift of six feet.

The whole of this ponderous machinery was supported on beams of wrought-iron, of immense strength, which spanned the tower above the tube.

The time occupied in making each lift of six feet was about 38 minutes. The precaution was taken to underbuild the tube with brickwork in cement, filling up the recess in the towers. During the lift, a packing of thin wood was introduced between the top of the brickwork and the bottom of the tube, that, in case of accident, an inch might be the greatest distance fallen through. That these precautions were not needless, was shown on the 17th of August, when the bottom of the cylinder of the single press broke, and allowed the tube to descend on to the packing. No serious injury was done to the tube, though the delay in procuring a new cylinder was considerable. By the 13th of October the full height was reached.

The expansion and contraction of such a length of metal is considerable, even under ordinary changes of temperature. Its effects are rendered more manageable by allowing the tube to rest in the Britannia Tower, and to expand outwards in both directions; there being arrangements of rollers, &c., in the land-tower abutments, to facilitate its motion. The greatest motion hitherto observed in each half is $3\frac{3}{8}$ inches. By a simple arrangement of clockwork moving a ruled paper (the tube itself carrying a pencil,) a daily register of this motion is kept.

The second tube was floated on the 4th of December, and lifted to its place on the 7th of January, 1850. The last of the land tubes for the first line was lowered to its place on the 4th of March, and on the 5th, Mr. Stephenson and staff passed through with a monstrous train, drawn by three locomotives.

Ten days after this, the line was tested by the Government Inspector, with a train 434 feet long; which caused a deflexion of not $\frac{3}{4}$ inch.

The third tube was floated on the 10th of June, and deposited on its permanent bed on the 11th of July. The fourth tube was floated on the 25th of the same month, and placed on the 12th of September.

The total weight of the tubes is nearly 11,000 tons. This weight is made up of 9360 tons of wrought-iron, and more than 1200 tons of cast-

iron and timber. They are composed of about 186,000 separate pieces of iron, pierced by more than 7,000,000 of holes, and united by upwards of 2,000,000 rivets, the angle and T-iron being not less than 83 miles in length. The weight of the lifting chains alone, at each end of the tube, was more than 40 tons, which, with the cross-head and ram of the press, made a total of more than 60 tons to be lifted before any effect could be produced on the tube itself. Of the masonry in the towers and abutments, there was about 2,500,000 of cubic feet; the weight in all being about 150,000 tons. Allowing twelve working hours in the day, and six to the week, this masonry was prepared and laid at the rate of three cubic feet per minute during the whole time of construction.

The resident engineers, to whose charge the execution of the masonry and ironwork was confided, were, respectively, Mr. Frank Foster, and Mr. Edwin Clark. The designs for the masonry, were by Mr. Francis Thompson.

One of the tubes was constructed by Messrs. Farforth, and the remainder by Mr. Charles Mare. The hydraulic presses and lifting arrangements were elaborated by Messrs. Easton and Amos; and the contractors for the masonry were Messrs. Nowell, Hemmingway, and Pearson.

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*Cornish Engines.**

The number of pumping engines reported this month is 26. They have consumed 2,854 tons of coal; and lifted 26,000,000 tons of water 10 fathoms high. The average duty of the whole is therefore 51,000,000 lbs. lifted one foot high by the consumption of 94 lbs. of coal.—(*Lean's Engine Reporter, 12th February.*)

Railways of the World.†

It is stated in a work recently published, that there were in operation at the commencement of 1849, in different parts of the globe, a total length of 18,656 miles of railway, on which a capital of £368,567,000 had been actually expended. In progress of construction, a further extent of 7829 miles, the cost of which, when completed, would be £146,750,000.

A Description of the Royal Border Bridge, erected over the River Tweed, on the line of the York, Newcastle, and Berwick Railway. By Mr. G. B. Bruce, *M. Inst. C. E.*‡

This viaduct, the total length of which was 2160 feet, and the extreme height 129 feet, consisted of 28 semi-circular arches, each 61 feet 6 inches span; and the whole constructed of stone, with the exception of the inner part of the arches, which was of brick laid in cement. It was divided

* From the London Railway Journal, No. 611. † Ibid 606.
‡ From the London Mining Journal, No. 810.

into two parts by a central abutment, which enabled the land arches to be completed, and, along with a temporary timber bridge, to be brought into use for public traffic, before the completion of the river arches, which necessarily occupied a considerable period in execution, owing partly to very substantial coffer-dams having been requisite for the river piers, but principally to its having been thought advisable to pile the foundations of most of those piers, as the bed of the river was liable to be scoured away by the rapid stream. The piles, both of the coffer-dams and of the foundations, were mostly of American elm, as it was found that the heads of the Memel piles required to be frequently cut off and re-hooped, when driven by Nasmyth's steam pile-driver, which was almost entirely used, both on account of expedition and of economy; for it was proved that whilst the hand ram only gave one blow in four minutes, the steam pile-driver gave 60 blows in one minute, and that the cost of the former was 2s. per lineal foot, whereas that of the latter was very little more than 1s. per lineal foot. It was also remarked that the force was more advantageously employed in the case of the steam pile-driver, as, on account of the ram being heavier and the fall less, the piles were not so frequently split.

The piers had an ashlar facing, and were filled in with well grouted rubble, having occasional through courses of ashlar, and an ashlar tie in the centre of their width from top to bottom. Great care was taken in the preparation of the mortar and the grout used in this work, and after a variety of experiments, the plan finally adopted was—in the case of setting lime for ashlar—to grind quicklime dry by itself, in a common mill, and then to mix it with coarse sharp sand, screened out of gravel taken from the bed of the river, in the proportion of three of sand to one of quicklime; this was then put under cover until required. Lime to be used for grout was also ground dry, and along with it was ground slag from an iron furnace, then gravel from the river was mixed with it without being screened, the proportions being quick-lime one, slag three-quarters, and gravel two and a quarter. The mortar when used had absorbed a sufficient quantity of moisture from the atmosphere and the sand, to prevent its being too hot for use, and yet, as it had not been previously mixed with water, and wrought into a paste, it retained its original setting power. This mortar required to be used very soft, and the stones to be well wetted, and as the sand was very coarse, thick joints were necessary, but in a few weeks it set as hard as Roman cement. All the lime used in this work was from the mountain limestone of the Scremerston and Lowich districts of Northumberland.

The centres, which were stated to have been of peculiar construction, were supported entirely from the piers, so as to prevent any accident happening, if the scaffolding was injured, either by the heavy floods of ice to which the River Tweed is subject in winter, or from the vibration of passing trains; as when the idea was entertained of having a temporary bridge, the intention was merely to add to the contractors' scaffolding, and to make it serve for both purposes. This intention was, however, abandoned, and an entirely separate timber bridge was erected on the east side of the stone bridge, at a cost of £14,340.

The total cost of the Royal Border Bridge was £120,000, and of the whole contract, one mile in length, in which it was comprised, £207,000, including an embankment, which had to be made entirely from side cutting, and which contained probably 760,000 cubic yards.

Some valuable and interesting experiments and observations were given on the velocity and regimen of the River Tweed, and the results compared with the theories generally laid down relative to running waters, by Buat and Eytelwein; and it appeared that although both approximated closely to actual experiment, Buat's formula gave the best result.

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*Railway Accidents.**

By the returns made to the Railway Commissioners, it appears that the total number of persons of every description killed and injured on all the passenger railways, open for public traffic in Great Britain and Ireland, during the half year ending 30th June, 1850, amounted to 93 killed and 68 injured. Of these, 3 passengers were killed and 33 injured from causes beyond their own control; 7 passengers killed and 3 injured owing to their own misconduct, or want of caution; 25 servants of Companies or of Contractors were killed and 17 injured, from causes beyond their own control; and 29 killed and 10 injured, owing to their own misconduct or want of caution. 26 trespassers and other persons, neither passengers nor servants of the Company, were killed, and 5 injured, by crossing or walking on the railway. Three persons committed suicide. The number of passengers conveyed during the half-year amounted to 31,766,503. The length of railway open on the 31st December, 1849, was 6032 miles, and on the 30th June, 1850, 6308 miles, showing an increase during the half-year of 276 miles.

Cannot some of our correspondents or readers give us a similar statement of the accidents on our American roads for comparison with this? Englishmen who visit this country rarely fail to be horrified by the careless management of our railroads and steamboats, but we doubt whether our accidents are as frequent as is here shown. Ed.

AMERICAN PATENTS.

List of American Patents which issued from March 18, *to April* 15, 1851, (*inclusive,*) *with Exemplifications by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

23. For an *Improvement in Trunk Handles;* Elijah A. Andrews, New Britain, Connecticut, March 18.

"My improvement consists in casting the lifting handle in two parts, complete, so that, when taken from the mould, the movable part may be slipped into the spaces in the plate or stationary part, and immediately attached to any piece of furniture for use, without any riveting or otherwise fastening the parts together."

Claim.—"What I claim as my invention, is casting the article in two parts, in such a

* From the London Railway Journal, No. 610.

form that they may be put together without any alteration of the parts, and so that they cannot get out of place, when the handle is attached to a trunk or other article, when the whole is constructed substantially as described."

24. For an *Improvement in Delivering Parti-Colored Warps in Weaving;* E. B. Bigelow, Clinton, Massachusetts, March 18.

"The object of my invention is to avoid, as far as possible, any defect in the figures on the cloth, by reason of any irregularity in the printed figures on the warps."

Claim.—"What I claim as my invention, is the method, substantially as herein specified, of producing figures that will match, on tapestry carpets, or other fabrics woven with printed warps, by the employment of a clamp or clamps, to be clamped on to the warps, as specified, in combination with belts, or their equivalents, having a positive delivery motion, and to which the said clamp or clamps can be attached at given distances, as specified."

25. For an *Improvement in Jacquard Looms for Weaving Cut-pile Fabrics;* Erastus B. Bigelow, Clinton, Massachusetts, March 18.

"My invention relates to power looms for weaving cut-piled fabrics double, in connexion with the jacquard, for producing the figures thereon; a most desirable union, and one which has never before, to my knowledge, been accomplished."

Claim.—"What I claim as my invention, is combining with the power loom for weaving cut-pile fabrics double, substantially as described, a jacquard machine for producing the figures on such fabrics, as described.

"I also claim, in the weaving of cut-pile fabrics double, with the figures produced by the jacquard dividing the figuring warps, so that one-half (or nearly so) of the figuring warps shall be in connexion with each of the cloths or fabrics, substantially in the manner and for the purpose specified.

"I also claim for the weaving of cut-pile fabrics double, as described, the double and reversed arrangement of the jacquard, substantially as described.

"I also claim, in the weaving of fabrics of the kind herein described, passing the double fabric between two vibrating bars having curved faces, to determine the length of pile between the two cloths, in combination with the two rollers, or their equivalents, over and under which the fabrics pass, after they have been separated, substantially as described; and this I also claim, in combination with a vibrating knife or knives, for cutting the pile, to separate the two fabrics, as described."

26. For an *Improvement in the Fastenings of Scythes to the Snaths;* E. S. Clapp, Montague, Massachusetts, March 18.

"The nature of my invention consists in certain improvements in the mode of attaching and securing the blade of the scythe to the snath, by which I am enabled to regulate the position of the blade with regard to the snath, or to set the edge more up or down."

Claim.—"What I claim as new in my invention, is setting the edge of the blade up or down, or more or less obliquely, by means of the adjusting screw in combination with the edge of the aperture, which forms the bearings of the two sides of the shank of the blade, substantially in the manner herein set forth."

27. For *Improvements in the Method of Casting the Backs upon the Teeth of Curry-Combs;* James M. Gardner, Troy, New York, March 18.

"In my improved method of making curry-combs, the teeth are cut in a series of sheet iron plates, which are arranged in a mould, together with an iron spike to be driven into a wooden handle, and the back and ferrule cast on, to secure the whole together and complete the comb."

Claim.—"What I claim as my invention, is the employment of a bar, in combination with the cope of a two-part flask, for casting the back on to the plates of curry-combs, the said bar being notched, to receive and hold the said plates during the process; all substantially as described."

28. For an *Adjustable Cut-Off;* Samuel H. Gilman, Cincinnati, Ohio, March 18.

"The principal objects of my improvements are, 1st, The application to a slide steam valve of an arrangement of cut-off mechanism, actuated by the movement of the valve rod, and having the periods of its cut-off action either subject to the momentary control of the engineer, or dependent on the movement of the steam governor, thus constituting the cut-off action a means of regulation of the rate of the engine.

"2d, In the devices, whereby a portion of the cut-off apparatus is made operable as a throttle valve."

Claim.—"Having thus particularly described the nature of my improvements, what I claim therein as my invention, is, 1st, the tappet *t*, vibrated by the impact of projections upon the slide valve rod, and lifting thereby a puppet valve, which admits steam to the slide valve chamber, during periods varying with the height to which the tappet is placed by the elevation or depression of the sliding rod, or other object to which it is pivoted, said rod being raised or depressed by a motion derived from the governor, or communicated to it in such other manner as may be deemed expedient.

"2d, I claim the mechanism substantially as described, for the prolongation of the admission of steam beyond the period at which it would be cut off by the tappet, to wit: the sliding plate *w*, and the intervening bar *o*, the former with a pair of receding inclined planes or edges, and the latter with an equal and parallel pair of salient planes, which, by sliding upon the former, hold up the puppet valve after the tappet has ceased to act, for a period likewise depending upon the movement of the rod, which latter may be actuated as set forth in the former claim."

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29. For an *Improvement in Cylinders for Figuring Looms;* Eliakim M. Hastings and John Shepherdson, Jamestown, New York, March 18.

"The distinguishing feature of our invention consists in a cam wheel of a particular construction, by which a series of shifting or movable cam pieces are inserted with blank pieces of equal thickness, in slots made lengthwise of such wheel, in the face of the same; which cam pieces are made to act upon a set of slide pieces, attached by or through a cord to the heddles or harness of the loom, and by which the figure or tweel of the web is dictated and determined."

Claim.—"What we claim as new, is the mode of connecting the movable cams *d*, and and slide pieces I, with the drum H, substantially as set forth, and for the purpose herein stated."

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30. For an *Improvement in Scythe Fastenings;* Ebenezer G. Lamson, Shelburne, Massachusetts, March 18.

Claim.—"What I claim as my invention, is the method substantially as herein specified, of securing or fastening the scythe to the snath, by means of the clamp jaws acting on the beveled or curved edges of the wedge-formed shank, in combination with the method of holding down the edge of the shank by means of the till thereon, which works on to the toothed plate of the recess, as described, whereby the scythe is held more firmly to the snath, to resist all strain, than by any other method heretofore practised.

"And I also claim the method, substantially as described, of spotting the scythe, that is, regulating the line that it shall have relatively to the curves of the snath, by means of the movable or adjusting plate *e*, the edge of which forms the bed for the shank of the scythe when drawn down to the clamps, as described."

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31. For *Improvements in Jacquard Machines;* John Scott and John Tannahell, Philadelphia, March 18.

"The nature of our invention consists, 1st, in an improvement in the manner of operating the cylinder, for the purpose of turning it and changing the pattern card more quickly.

"2d, In applying tubular leaden weights to the tail cords above the harness of the loom, for the purpose of keeping tension on them, and ensuring their proper operation, as the trap boards are raised or lowered."

Claim.—"What we claim as new in our invention, is, 1st, the manner of operating the cylinder by means of the double lockers, O O, in combination with the springs, P P, whereby its complete operation is effected by the upward motion of the trap board, C′, substantially as and for the purpose herein described.

"2d, The application of weights, *l l l l*, to the tail cords above the harness, for the pur-

pose of more effectually keeping them tight or straight, and thereby ensuring the more correct operation of the trap boards and needles upon them, substantially in the manner herein set forth."

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32. For an *Improvement in the Construction of Bee Hives;* Albert J. Surles, Florence, Georgia, March 18.

Claim.—"What I claim as my invention, is having the comb placed within the trap, I, fortified or protected from the moth or other insects, by the diaphragm, M, substantially in the manner herein fully explained."

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33. For an *Improvement in Removable Handles to Sad Irons;* T. R. Timby, Meridian, New York, March 18.

Claim.—"What I claim as my invention, is the method herein described of constructing sad, tailors', and other hand smoothing irons, with handles, which can be readily and securely attached to the iron, and easily detached therefrom, substantially as herein specified."

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34. For an *Improvement in the Construction of Metallic Buildings;* Simon Willard, Cincinnati, Ohio, March 18.

"The nature of my improvement consists in the manner of constructing metallic buildings, so as to possess great strength, durability, security, economy, and be perfectly fire and water proof."

Claim.—"What I claim as new and of my own invention, is carrying up the vertical U shaped flanch binders between the flanches of the roof plates to which they are attached, thus supporting the roof, and binding it firmly to the building.

"I also claim such binders, attached in such a manner, in connexion with the tie plates or rods, Q, attached at the same spot between the flanches and by the same bolts, and this I claim, whether the suspension bars, R, be employed or not."

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35. For an *Improvement in Adjustable Land Sides of Ploughs;* George Heffley, Samuel Conrad, and James Wigle, Berlin, Pennsylvania, March 25.

"The nature of our improvements in the plough, consists in the arrangement, combination, and use of a separate adjustive heel and rest, attached to the land bar, for the purpose of regulating and governing the depth of the furrow at pleasure, with great ease and exactness, and which prevents the wearing away of the land bar, as is experienced in the ordinary plough, and, in addition, entirely supersedes the necessity of the usual separate land bar."

Claim.—"Having thus described our improvements in the plough, we wish it to be understood, that we do not claim the employment of an adjusting plate for elevating the rear portion of the plough, to regulate the furrow. But what we do claim as our invention, is providing a right angled heel plate, L, with a hook, P, for the purpose of interlocking with a hooked shaped projection, Q, attached to the land bar, forming a hook joint; said heel plate, L, forming the bottom and side of the land bar, and having its rearward portion susceptible of vertical adjustment by means of a screw, T, and when adjusted, being clamped by a horizontal screw bolt, N, its shank being placed in a segmental slot, to admit of its moving with the heel plate, as described."

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36. For an *Apparatus for Securing Shutters in any Required Position;* Charles W. Krebs, Baltimore, Maryland, March 25.

Claim.—"What I claim is the right to the rods, pintles, sockets, screws, and apertures connected, arranged, and acting, substantially in the manner and for the purposes described."

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37. For an *Improved Sash Lock;* Michael Norton, Cambridge, Massachusetts, March 25.

Claim.—"What I claim consists in the spring, F, to throw the turning hook outwards, the spring catch, G, applied to the frame of the hook, and the projection, H, extending either from the curved rail or the lower window sash, in combination, together and with

the said clamp hook and rail, the whole being made to operate substantially in the manner as herein before specified."

38. For an *Improvement in Extension Tables;* Lewis Thorn, Philadelphia, Pennsylvania, March 25.

Claim.—"Having thus fully described the construction and operation of my improved extension table, what I claim as new and of my invention, is, 1st, the slides, E and F, in combination with the cross bars, G, and folding rails, I; and, 2d, the recess for the reception of the loose leaves, being formed substantially in the manner and for the purpose set forth."

39. For an *Apparatus for Moving and Securing Shutters, &c.;* N. W. Speers, Cincinnati, Ohio, March 25.

Claim.—"What I claim as my invention, is the manner of opening and closing window shutters from the inside, and securing them firmly at any point in their semi-circuit, by means of the horizontal screw shaft, B, inserted in an opening in the lower portion of the window frame, metallic nut, E, surrounding the same, and the bar or plate, F, attached to the shutter, substantially as described."

40. For an *Improved Apparatus for Drawing and Measuring Liquids;* Richard F. Stevens, Syracuse, New York, March 25.

"The nature of my invention consists in combining a measure or measures, with faucets or gates, and in drawing liquids from cans, casks, barrels, &c."

Claim.—"What I claim as my invention, is the combination of measures with faucets, cocks, or gates, used in drawing liquids from cans, casks, barrels, &c., in such a manner that by opening the faucet attached to the cask, the measure will be filled; then, by closing the same, the desired amount may be drawn by opening the corresponding faucet in the measure, the whole combined substantially as described, and for the purpose set forth."

41. For an *Improvement in Scythe Fastenings;* Nathaniel Lamson, Shelburne Falls, Massachusetts, March 25.

Claim.—"What I claim as my improvement, is the combination of the two wedge shaped bearers H, I, the confining bolt F, and the support at the extreme or other end of the shank, as constructed, substantially in the manner specified, the whole being for the purpose of enabling a person to change the positions of the blade of the scythe in a direction transversely of the plane of the blade."

42. For an *Improvement in Machines for Preparing Clay for Making Brick;* Heman Whipple, Port Richmond, New York, March 25.

Claim.—"What I claim as my invention, is the use of a revolving screen, constructed of bars *a*, *a*, *a*, *a*, set at a slight inclination from the horizontal position, having lugs or crushers, *c*, *c*, *c*, *c*, *c*, within it, each lug being hung or suspended at one end on a bar, O, and prevented from touching or rubbing the screen by cord or chain *i*, attached to its other extremity, and rod *p*, supporting it, or constructed and operating in any manner substantially the same, and for the purpose herein set forth."

43. For an *Improvement in Upright Piano-Fortes;* Henry Klepfer, Cincinnati, Ohio, March 25.

Claim.—"What I claim is the arrangement of the sounding board in upright pianos, between the strings and the performer, substantially in the manner described."

44. For an *Improvement in Scythe Fastenings;* Nathaniel Lamson, of Shelburne Falls, Massachusetts, March 25.

Claim.—"I claim the arrangement of the hole or holes *f*, *f*, *f*, of the head of the confining clasp, in such manner, with respect to the axis *g*, of the screw H, that when the said screw is turned one hundred and eighty degrees, the position or positions of the same

(viz., the hole or holes) may be changed in such manner as to secure one or more new and different positions for the shank, the same being for the purpose as specified."

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45. For an *Improvement in Balanced Valves;* Francis B. Stevens, City of New York, March 25.

Claim.—"I do not claim as my invention, valves having seats of such relative diameters, that they shall be retained thereon by the pressure of steam; but what I claim as my invention, is in the above description of valve, where the disk is held by a support running up through the hollow valve, so forming the valve that the upper seat shall be larger in diameter than the lower one, by means of the ring *r* attached to the valve, and by means of the ring *s* attached to the seat, or by any means substantially the same, for the purpose of retaining the valve in its seat by the pressure of steam, whenever its position or location, in respect to the steam passages, is such that the pressure of steam is below the valve when closed."

RE-ISSUES.

1. For an *Improvement in Carriages;* John Jones, Clyde, New York; patented January 14, 1851; re-issued, March 4, 1851.

"The nature of my invention consists in constructing carriage reaches in such a manner as to prevent a rocking or zig-zag motion, on plank or descending roads; and, also, in an arrangement to allow the carriage to cramp any desired degree without having the wheels strike the body, to throw the wheels apart on the same side of the carriage, by giving motion to the hind as well as the fore axle-tree; thus facilitating the ease of getting into and out of carriages, and rendering it impossible to upset the carriage by cramping."

Claim.—"What I claim as my invention, is the arrangement of two bars or reaches, placed in connexion with the straight reach, as above described, and in combination with the spring, rod, and cross-bar, substantially in the manner described."

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2. For an *Improvement in Cutting Stone;* Charles Wilson, Springfield, Massachusetts; patented March 13, 1847; re-issued March 4, 1851.

"The principle of my invention, and that which distinguishes it from all other things before known, consists in dressing, or facing, and reducing stone, and other like substances, particularly such as are of a frangible nature, by the use of a rolling edge, or edges, acting against the face or surface of such substance, and by a series of actions, each reducing a small portion of the material."

Claim.—"What I claim as my invention, is the method, substantially as above described, of dressing, facing, or reducing stone, and other like materials, by means of a rolling edge, or edges, acting against the face or surface of the material to be worked, substantially as herein described."

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3. For an *Improvement in Fire Arms;* William W. Hubbell, Philadelphia, Pennsylvania; patented July 1, 1844; re-issued March 11, 1851.

(See Specification page 323.)

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4. For an *Improvement in Evaporators and Condensers;* Edward Lynch, Brooklyn, New York; patented July 18, 1848; re-issued March 11, 1851.

"My evaporator is so combined with the condenser, that the vapor generated in the evaporator shall pass to the condenser, to be condensed with the exhausted steam, for the purpose of supplying fresh water to the boiler in sufficient quantity to supply the waste."

Claim.—"What I claim as my invention, is the partition, *n*, within the tank, for the purpose of dividing the water of the evaporator from that of the condenser, in the manner and for the purposes substantially as herein set forth."

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5. For a *Composition for Covering Hams;* Horace Billings, Beardstown, Illinois; patented April 9, 1850; re-issued March 25, 1851.

Claim.—"I do not intend to claim as my invention, the covering of meats, or other

articles, with paper and cloth, or other flexible material, previous to coating them with my preserving composition; but what I do claim as my invention, is the formation of a preserving composition for coating meats, cheeses, fruits, vegetables, &c., by the union of rosin, shellac, (or seed lac,) and linseed oil, (or other oil of a similar nature,) substantially in the manner, and in nearly the proportions as herein set forth."

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6. For an *Improvement in Washing Machines for Cleaning Rags;* James Phelps, West Sutton, Massachusetts; patented November 24, 1843; re-issued March 25, 1851.

Claim.—"What I claim as my invention, is an adjustable, rotating water elevator and strainer, arranged substantially as herein set forth, in such a manner that it can be raised or lowered in the vat of the washing or beating engine, to vary the quantity of water discharged therefrom; or can be raised entirely from the vat to stop the discharge of water, or for other purposes, as herein set forth.

"I also claim a rotating prismatic screen, or strainer, for straining the water from the paper stock in the vat of a washing or beating engine, in combination with devices for discharging the strained water; the prismatic screen being not only more efficient than a cylindrical screen, but also admitting of more ready repair."

DESIGNS.

1. For a *Design for Furnace Registers;* Gardner Chilson, Boston, Massachusetts, March 4.

Claim.—"What I claim as my production, is the new design herein above described, for a register in the form of a circle, having within and near to its outer ring two concentric rings, the space between each of said rings being ornamented with curved lattice work, forming hyperbola shaped openings, and a ring in its centre, enclosing an eight-leaved star, with a small circle in its centre, and curved and notched branches radiating from the said ring to the smaller of the outer rings, forming irregular and heart-shaped openings, all as herein above described and shown in the drawing."

---

2. For a *Design for Furnace Registers;* Gardner Chilson, Boston, Massachusetts, March 4.

Claim.—"What I claim as my invention or production, is the new design herein above described, for a register for furnaces, &c., of rectangular form, having within it a smaller rectangle connected to the edge of the register by curved bars, of the shape shown in the drawing, said inner rectangle having a square in each corner and small rectangles within its sides, said squares being ornamented with curved bars forming the lattice work *h*, *h*, *i*, *i*, &c., and said smaller rectangles being ornamented with semi-circular and diamond-shaped lattice work, and a rectangle in the centre of the register, ornamented with irregular curved branches or bars proceeding from its sides to a ring enclosing a four notched leaved star; the whole forming a lattice or open work for the heat to pass through, all as herein above described."

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3. For a *Design for Furnace Registers;* Gardner Chilson, Boston, Massachusetts, March 4.

Claim.—"What I claim as my production, is the new design herein above described, for a register of rectangular form, having within its sides two smaller rectangles, one within the other, the space between the outer bars of the register and the larger rectangle being ornamented with curved lattice work, and the triangular openings *e*, *e*, and the space between the two inner rectangles being ornamented with irregular heart and diamond-shaped openings, while the centre of the register is occupied by a five oval-leaved star in a ring, with curved and notched branches or bars running from said ring to the inner rectangle, all as herein above described and represented in the drawing."

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4 For a *Design for Registers for Furnaces;* Gardner Chilson, Boston, Massachusetts, March 4.

Claim.—"What I claim as my invention or production, is the new design herein above

described, for a register of rectangular form, having within its sides a smaller rectangle, the space between the two being ornamented with the circular and diamond-shaped lattice work, shown in the drawing; the inner rectangle being ornamented with irregular curved bars or branches, running from its sides to a ring in its centre, which encloses a five-pointed star with curved sides; the whole forming a lattice work for the passage of the heat, all as herein above described."

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5. For a *Design for Stoves;* Samuel W. Gibbs, Assignor to Jagger, Treadwell & Perry, Albany, New York, March 4.

Claim.—"What I claim is the combination and arrangement of ornamental figures and forms represented in the annexed drawings, as making an ornamental design for a six-plate stove."

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6. For a *Design for Stoves;* Samuel W. Gibbs, Assignor to Jagger, Treadwell & Perry, Albany, New York, March 4.

Claim.—"What I claim as my production, is the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for the side of a cooking stove, and the back and front plates of the elevated oven."

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7. For a *Design for Stoves;* John S. Perry, Albany, New York, March 4.

Claim.—"What I claim as my invention, is the combination and arrangement of ornamental forms and figures represented in the accompanying drawings, and forming a design for an ornamental cooking stove."

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8. For a *Design for Stoves;* Samuel W. Gibbs, Assignor to Jagger, Treadwell & Perry, Albany, New York, March 4.

Claim.—"What I claim as my invention, is the combination and arrangement of ornamental figures shown in the accompanying drawings, forming a new ornamental design for an air-tight box stove."

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9. For a *Design for Pedestals and Columns;* Wm. & Wm. H. Lewis, City of New York, March 25.

Claim.—"What we claim as new and of our own invention, is the design and configuration shown in fig. 1, as attached to or formed on the pedestal in alto-relievo, as described and shown; and we also claim the design shown in fig. 2, as forming the base of the column, attached as described and shown."

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10. For a *Design for Parlor Grates;* Joseph Pratt, Boston, Massachusetts, March 25.

Claim.—"What I claim as my production, is the several ornamental mouldings round the hearth plate, ash-pan, and front and top plates, above described and represented in the drawings, with the ornaments above specified and shown in the several drawings, as cast on the front and top plate, and blower and top of the grate, forming a new design for a parlor grate."

APRIL.

1. For an *Improvement in Machines for Folding and Measuring Cloth;* Henry Boot, New Bedford, Massachusetts, April 1.

Claim.—"Having thus fully described my invention, I will proceed to state what I claim as new. 1st, Folding the cloth as it passes through or between the calender rollers during the process of calendering, or by passing it through or between a pair of revolving rollers E E, similar to calender rollers, the said calender or other rollers being hung in a carriage F F G, which receives a reciprocating motion above or across a table C, and a tilting motion at each end of its stroke, so as to bring each roller, alternately, to bear on the table as it (the carriage) moves in different directions across it, thereby laying the

cloth under the rollers on the table in folds or layers in the manner substantially as herein described.

"2d, Making the reciprocating motion of the calender rollers of a certain fixed length, such length determining the length of the fold, and thereby measuring the cloth substantially in the manner herein described. At the same time I wish it to be understood, that I do not claim the measurement of cloth by folding it in layers or folds of a certain length, unless such layers or folds are laid by calender or other similar rollers."

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2. For an *Improved Horse-Shoe Nail Machine;* Marshall Burnet, Boston, Massachusetts, April 1.

Claim.—"Having thus fully described my invention, I claim therein as new, making a horse-shoe nail by means of a stationary former, and a series of traveling and rotating cams, arranged and operating substantially as herein described and fully shown."

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3. For an *Improved Machine for Sticking Pins on Paper;* Chauncey O. Crosby, New Haven, Connecticut, April 1.

Claim.—"In the machine which I have now fully and exactly described for sticking pins crosswise of narrow fillets of paper, to prepare it, when so stuck, for winding, and winding the same into coils, there are several parts which are common, or such as have been used by others, which I do not claim separately, nor in other combinations.

"I do not claim the upper feeding channel or inclined conductors when made of straight bars, nor cylinders with parallel sides which have been used for conducting wood screws and similar headed articles, nor the downward curved conductors, nor any other feeding channels, unless they are combined with the conical form of rollers or the separator.

"I do not claim the crimps, nor any peculiarity in inserting the pins through them, if made crosswise of the sheet, and the pins inserted lengthwise of it, and not crosswise of both the crimps and fillet, or ridges raised in it.

"I do not claim or use any kind of crimping 'bars,' 'jaws,' or 'clamps,' as they have been heretofore used.

"And, generally, I wish it to be distinctly understood, that I do not limit myself to the precise form or arrangement of parts, nor the particular devices for moving them, for these may be much varied without changing the principle of my invention as set forth. Nor do I limit myself to the single process of inserting only one pin at once on only one edge of the fillet, for on the same principle, with only circumstantial variation of the machinery, I can insert several pins at once on the same edge of the fillet, or on both edges of it, and other similar variations can be made by any competent machinist, without any essential or substantial variation from the character of my invention as herein described and set forth.

"1st, I do claim the conical form of rollers to constitute my feeding channel for arranging the pins, and moving them forward in the channel with the most suitably decreasing rates of descending velocity, as herein described.

"2d, I do claim also, as my improvement and invention, the combination of the parts, and the adaptation of my machine for feeding the pins, separating and delivering them, crimping the fillet, and sticking the pins crosswise of such fillet, and finally rolling the fillet into a coil, substantially in the manner described.

"3d, I claim, also, the screw separator as described, placed in the feeding channel to restrain the natural descent of the column of pins, so that they may be delivered as fast and no faster than they are required for sticking, substantially as herein described and set forth."

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4. For an *Improvement in Wheat Fans;* John Hollingsworth, Zanesville, Ohio, April 1.

Claim.—"Having thus fully described my invention, I claim therein as new, two or more chambers and areas in combination with a fan, for the purpose of cleaning and separating grain by using one and the same blast (to clean it) over and over again, any number of times, as herein fully described and represented."

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5. For an *Improvement in Mills for Grinding Paints and Drugs;* Gilbert D. Jones, Jersey City, New Jersey, April 1.

Claim.—"What I claim as of my own invention, is the construction of a mill in which

the grinding surfaces shall consist of a plane or planes operating upon a cone, as herein described.

"I claim, also, the lever *k*, in combination with the muller, for the purpose of regulating the feed, the whole being constructed substantially in the manner as set forth herein."

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6. For an *Improvement in Rice Hullers;* Peter M'Kinlay, Charleston, South Carolina, April 1.

"The nature of my invention consists in operating the pestle by attaching it to a rod, which passes through the bottom of the mortar, and is attached to a connecting rod, which connects it to a crank on a shaft, having its bearings in levers so arranged below the mortar as to allow of the pestle being adjusted at any required height in the mortar."

Claim.—"Having described my invention, I will now state what I claim as new. I claim operating the pestle by having it attached to a rod passing through the bottom of the mortar, and receiving motion through a crank, or its equivalent, placed below it, substantially as and for the purpose herein set forth."

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7. For *Improvements in Blasting Rocks;* Charles Monson, New Haven, Connecticut, April 1.

Claim.—"And now to sum up, in brief, what I claim as my invention, it may be sufficient to state, 1st, I claim the use of an artificial binder, by means of which to restrain the action of the blast in opposite directions, by offsetting said action against itself, substantially as herein before explained."

"2d, I claim the use of the little packing wedge, or wedges, within the charge or blast chamber, substantially as described."

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8. For an *Improved Machine for Forming a Lock on Sheet Metal;* Jabez Walker, East Bloomfield, New York, April 1.

Claim.—"Having thus fully described my invention, I will now proceed to state what I claim therein as new. I claim the employment of a cam or cams *g g*, on the tumbler D, operating on levers E E, connected with the under side of the movable jaw C, in combination with a spring or springs *l*, substantially in the manner described, for the purpose of closing the lip *e*, and securing the plate while folding and raising the lip, and releasing the plate after the folding is completed."

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9. For an *Improvement in Wheat Fans;* Jesse White, Barnesville, Ohio, April 1.

"My invention consists in effecting any one or all the operations of elevating, conveying, and cleaning grain, by means of a current of air, produced artificially, with sufficient velocity to carry the grain along with it, through the tube or other channel through which it is forced."

Claim.—"What I claim as my invention, is the combination of the fan, air trunk, and head, constructed and operating substantially in the manner and for the purpose herein described."

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10. For an *Improvement in Bran Dusters;* John M. Carr, and James Hughes, Cambridge City, Indiana, April 1.

Claim.—"Having thus fully described our improvements, we wish it understood, that we do not claim the beater and fan revolving within an upright stationary beater and bolt, as these have before been used; but what we do claim is, the combination of the openings, (*d* and *l*,) both provided with valves or registers, with the runner and fan revolving within an upright cylindrical casing, the upper part of which acts as a beater, and the lower part as a bolting apparatus, substantially as described, for the purpose of separating the flour which adheres to the bran after undergoing the ordinary bolting; the said process being regulated and adjusted to suit the circumstances of weather, &c., by admitting more or less air, either above or below, by means of the registers, as set forth."

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11. For an *Improvement in Connecting and Disconnecting Wheels and Axles;* Simeon Heywood, Claremont, New Hampshire, April 1.

Claim.—"I do not claim the cap, the nut, or the axle; but what I do claim as my invention, is the dog and the spring, combined and operating as above set forth."

12. For an *Improvement in the Manufacture of India Rubber;* David M'Curdy, Newark, New Jersey, April 1.

"My invention consists in the discovery of new ingredients to be mixed with India rubber, which will cause a great improvement upon its strength and durability, and contractile force, and overcome the difficulty hitherto resulting from the necessity of treating most fabrics of rubber with steam, during the process of vulcanizing."

Claim.—"Having described my invention, and the best mode known to me of manufacturing the same, what I claim as my invention, is the combination of potash with rubber and sulphur, and submitting the same to a high degree of heat, whereby to produce the change upon rubber known as vulcanizing."

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13. For an *Improvement in Splint Machines;* Henry Mellish, Walpole, New Hampshire, April 1.

Claim.—"What I claim is the combination of the cylinders F and G, with their cutters J J attached, (for the purpose of giving a rounded form to the splints,) and the cylinder K, with its spurs *l*, (for the puprose of dividing the splints in one direction,) with the circular cutter or saw N, (for the purpose of separating the splints from the timber,) and the guide V, to guide the splints in the channel U, the whole being arranged substantially in the manner and for the purposes above set forth."

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14. For an *Improvement in Seed Planters;* Archibald Wieting, Middletown, Pennsylvania, April 1.

Claim.—"What I claim as new and of my own invention, is placing two or more hollow drill teeth in a direct line, one behind the other, managed and drawn by the same drag bar, the front tooth being made the largest, and so placed as to run somewhat deeper in the soil than its successor or follower, for the purpose of depositing fine manure or chemical agents beneath the grain when planted in rows or otherwise, as herein fully set forth and represented."

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15. For an *Improvement in Machines for Cutting Screws on Bedstead Rails;* H. Gross, and W. Campbell, Tiffin City, Ohio, April 1.

Claim.—"Having thus fully described our improvements in cutting screws, what we claim as new therein, is the peculiar form and manner of securing the V cutter to the cylindrical head, as described, that is to say, making the cutter as represented, and letting the tapered end of the shank into the recess, bringing the angular shoulder against the cylinder, and sustaining the beveled points against the interior beveled surface of the cylinder head, by which arrangement, the instrument during the operation of cutting is forced firmly against the head, the strain upon the confining screw being thereby greatly reduced, and the cutting tool itself strengthened."

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16. For a *Stone and Metal Conglomerate for Paving, etc.;* George H. Knight, Cincinnati, Ohio, April 1.

Claim.—"Having thus described the nature of my invention, what I claim therein as new, is, forming a block suitable for paving masonry work, or analogous purposes, of a conglomerate of iron and stone, by running the molten metal among broken stone within a mould, either with or without the devices, substantially as herein described, for jointing and locking together the contiguous blocks."

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17. For an *Improvement in Brick Presses;* John J. Riddle, Covington, Kentucky, April 1.

Claim.—"Having thus fully described the nature of my invention, what I claim herein as new, is, the lip *e*, hugging closely the rim of a wheel containing moulds, the said lip being a prolongation of a gradually narrowing feed trough, formed and operated after the manner and for the purposes substantially as herein described; namely, the formation (by pressure of untempered clay) of a uniform and coherent brick."

18. For an *Improvement in Sawing Machines;* Pearson Crosby, Fredonia, New York, April 8.

"The nature of my invention consists in making a circular saw with both faces convex, or swelled, so that it shall present a thin edge where the teeth are cut, to avoid waste of the lumber and reduce the resistance in cutting, and be gradually thicker towards the shaft to give it the requisite thickness, to prevent buckling, and insure a steady motion at the periphery, when this is combined with a fixed beveled gauge placed near the periphery of the saw, on that side of the shaft opposite to where the lumber is presented to the teeth, so that the said gauge shall separate or spread the two parts of the plank as they are being cut, and prevent them from binding against the face of the saw."

Claim.—"Having thus pointed out the nature of my invention, and the manner in which I have essayed the same with success, I will state that I do not wish to limit myself to the precise mode of constructing and arranging the parts, as these may be variously modified without departing from the principle of my invention.

"But what I claim as my invention, is making the circular saw with both faces convex, in the manner and for the purpose substantially as specified, when this is combined with the guide, substantially as specified, for spreading apart the plank, to prevent the binding of the saw as specified."

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19. For an *Improvement in Fastening down Table-Leaves;* Lewis J. Mason, Franklinville, New York, April 8.

Claim.—"What I claim as my invention, is the combination of devices, by means of which table-tops, of different forms and dimensions, can be readily secured to and disconnected from the same frame, as herein set forth."

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20. For an *Improvement in Brick Presses;* J. Z. A. Wagner, Philadelphia, Pennsylvania, April 8.

Claim.—"What I claim as my invention, is the combination of the mould wheel, with the grooved and smooth pressure roller, substantially as herein described; the grooved roller gauging and partially compressing the clay into the moulds, and forming a projecting band of clay, which is subsequently compressed into the moulds by the smooth pressure roller.

"I also claim the grooves in the mould wheel, in combination with the flanches of a hopper, which is supported on the frame of the machine independently of the mould wheel; by which arrangement the clay is prevented from escaping laterally, and working in between the teeth of the driving wheels; hence the latter can be placed near to the moulds, and the machine thus made more compact, while, at the same time, the danger of breaking is diminished.

"I likewise claim detaching the bricks from the pistons of the mould wheel, by means of the tappets and levers, as herein set forth."

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21. For an *Improvement in Apparatus for Bolting Flour;* Lewis Fagin and Henry C. Hayman, Cincinnati, Ohio, April 8.

Claim.—"Having thus fully, clearly, and exactly described the nature and operation of our joint invention, we wish it distinctly understood that we do not claim the broad principle of bolting meal by an air blast, as this has been imperfectly done before; but what we do claim as new, is the application of a blast cylinder with spiral issues, as described, to the process of bolting flour, or other pulverized material, by means of which, during a continuous blast, the meal is consecutively thrown against the bolting cloth, and so much as is not passed through at once, is given an interval of time to fall from the cloth and leave open the meshes, and is thus as it were re-fed to the impulse of the blast from each succeeding issue; the intermittent action at the same time causing eddies, that loosen, and, as it were, rip up the bran and flour from the cloth, separate the bran from the flour, and twirl the particles of bran in such a manner as to leave the flour free to pass through, while the bran, from the twirl thus given it, is caused to present its broadest surface to the bolting cloth, the specking of the flour being thereby prevented and avoided; the several parts being arranged substantially in the manner and for the purpose described.

"We also claim the insertion of a set of beaters at a suitable distance down the bolting cloth and blast cylinder, which, during the bolting process, shall interrupt the same at a time when the bran requires beating, in order to loosen the flour from it preparatory to the further continuance of the bolting process, substantially in the manner and for the purpose described.

"We also claim the chamber Y and I, by means of which the light flour, carried up by the escape of the blast, is regathered and returned to the usual gathering chamber S, substantially in the manner and for the purpose described."

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22. For an *Improved Saw Set;* Elijah S. Holkins, Painesville, Ohio, April 8.

Claim.—"Having thus described the operation of my improved saw set, what I claim therein as new are the following particulars:

"1st, Supporting the lever by which motion is given to the jaws, by means of an adjustable stirrup, constructed substantially as described, whereby said stirrup serves as a gauge in addition to performing its ordinary duties.

"2d, I claim the arrangement of the jaws constructed of one bent piece of metal, with the lever and stirrup, the handle of said lever projecting backwards towards the rounded part of the jaws; the whole being constructed substantially as herein described."

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23. For an *Apparatus for Setting up Ten-Pins;* Thomas J. Sloan, City of New York, April 8.

"The advantages of my improvements consist in the saving of time and labor in setting up the pins, saving the expense of an attendant for performing this duty, and the absence of liability to accident to persons from the flying of the pins or balls."

Claim.—"What I claim as my invention, is elevating the pins of a bowling alley, by means of a set of elevating sockets operated from the head of the table, when this is combined with any well known device or devices, which will permit the pins to fall and sustain them in a vertical position after they are elevated, substantially as described."

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24. For an *Improvement in Horse Powers;* Aaron D. Crane, Newark, New Jersey, April 8.

Claim.—"What I claim as my invention, is the manner of arranging and connecting the whipple-tree and brake, so that when the horse is drawing, the brake is off the wheel or pulley, and when not, is on and acting as a governor, as herein before described, for the purposes herein before set forth."

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25. For a *Tool for Making Jack Chains;* William Todd, Stamford, Assignor to Chas. Atwood, and Geo. Kellogg, Derby, Connecticut, April 8.

Claim.—"Having now fully described my invention, I disclaim all right to the grooved pin. But I claim the combination of the stud pins *i* and *i'*, with the bending stud and holding dog, arranged and acting substantially as described."

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26. For an *Improvement in Ladies' Work Tables;* Celia R. P. Foster, (late Celia R. P. Wood,) Canandaigua, New York, April, 8.

Claim.—"Having thus fully described my improvement, what I claim as new is the mounting of the upper leaf B, and disk G, with the drawers R R Q, on the rotary standard X, thus raising or lowering the whole to suit different persons by the screw L.

"2d, I claim the rotary disk with drawers hung thereon by the screw U, supported by the pin K, which can turn round the standard independent of the leaf or standard B X, and raised or lowered, as herein set forth."

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27. For an *Improvement in Grain Separators and Fans;* Roswell T. Merrill, Bloom field, Michigan, April 8.

Claim.—"What I claim as my invention, is constructing the elevator with double troughs *c c*, in the manner herein described, for the purpose of preventing the grain from falling through between the cells.

"I moreover claim the combination of the herein described elevator J, wind channel L, and plate valve *m*, with a grain threshing and winnowing machine, the former being constructed and arranged as herein described."

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28. For an *Improved Saw-Set;* Hiram Strait, Covington, Kentucky, April 8.

Claim.—"What I claim as of my own invention in the saw-doctor, is the adjustable double-beveled slide saw rest, constructed and used substantially as herein described, by means of which its beveled bed, the tooth rest, upper jaw and punch, saws of all kinds can be firmly held, and their teeth be either set in V form, shouldered in U form, or be both shouldered and set to any amount required to insure any degree of smoothness or roughness in sawing, whether their points are sharp or rounded."

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29. For an *Improvement in Winnowing Machines;* Jonathan L. Booth, Cuyahoga Falls, Ohio, April 8.

Claim.—"What I claim as my invention is the blast passages F G and *k*, arranged and controlled by the shutter J, in the manner and for the purposes substantially as herein set forth."

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30. For an *Improvement in Cooking Stoves;* Rufus K. Paine, Cincinnati, Ohio, April 8.

Claim.—"Having thus fully described the nature of my invention, what I claim therein as new, is the air passages *p q r*, between the fire back *l*, and the upper oven, the said passages receiving external air at the sides of the stove, and discharging it into the back flue in combination with the damper *m*, and flues *b c d e f g h*, substantially as herein described and represented, for the purpose of equalizing and regulating the heat to all parts of the ovens."

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31. For an *Improvement in Scythe Fastenings;* Oliver Clark, Medina, Ohio, March 18.

Claim.—"What I claim as my invention is, 1st, Making the shank C of curved or arch form longitudinally, as described, which enables it to be fitted to the snath, so as it may be set in or out by giving it a slight motion in a curved direction.

"2d, The mode of securing the shank C, so as to admit of the edge of the blade being set up or down, by making the cavity in the projection *a*, through which the shank passes, widest at the back, and making the back edge of the shank and the inner side of the tightening key E of corresponding arch form transversely, so that the shank may be held secure in any position."

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32. For an *Improvement in Material for Transferring Colors in Calico Printing;* Charles A. Broquette, Rue Neuve, St. Nicholas, St. Martin, France. Patented in France, April 1, 1849: in England, April 21, 1849. April 15.

Claim.—"I claim the use of extract of fibrine, to form with or without any other oily or fatty matters, by the means which I have described, or any other equivalent means, a mastic adequate to thickening and retaining on fibres, threads, tissues of every description, and of every material or substance, the archil color, and such other colors as are incorporated with that mastic.

"I also claim the above process of preparing and purifying the extract of caseine, in order, by the means which I have specified, or any other equivalent means, to impart to fibres, threads and tissues of vegetable nature of every description, by means of a preparation of mordant, the property of better uniting to or attaching the coloring matter of archil, and in general, other coloring matters, either in printing or dyeing, whether this preparation or mordant be applied on the fibres or threads of vegetable nature previous to the weaving, or whether it be applied after the weaving on tissues of vegetable nature, or on tissues composed partly of vegetable and partly of animal substances."

33. For an *Improved Milling Tool;* John Buckingham, and Joseph H. Baird, Watertown, Assignors to the Scovill Manufacturing Company, Waterbury, Connecticut, April 15.

Claim.—"The rotary die for making impressions on metals and other substances, is a well known instrument, and we make no claim founded on that instrument, in itself considered.

"But what we do claim, is, the combination of such die with an axle, on which the same may vibrate, which axle is at right angles with the axis of rotation, and not in the same plane, substantially in the manner and for the purposes herein set forth."

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34. For an *Improvement in Mill Stones;* E. T. Hanon Valcke, Paris, France, April 15.

"The object of my invention is, to secure the introduction of air between the stones, in sufficient quantities to prevent the grain from heating in the process of grinding, and to keep the pollen in a perfect state of freshness, which is the only means by which the substantial parts of the grain can be preserved from alteration."

Claim.—"What I claim as my invention, is, constructing the running stones of mills with oblique apertures or passages through the body of the stone, and provided with hoods or funnels to collect the air during the rotation, and connected on the grinding face of the stone with furrows, substantially as described, when this arrangement is combined with the use of vertical pipes, leading from the extremity of one of the apertures or passages, to a funnel leading to the next succeeding oblique passage in the body of the stone, substantially in the manner and for the purpose herein set forth."

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35. For an *Improvement in Iron Railings;* John Krauser, Reading, Pennsylvania, April 15.

"The nature of my invention consists in securing the palings to horizontal rods or bars of iron, by means of peculiar methods of operating the rods and palings with jaws to them, and in combination with other devices in castings herein described."

Claim.—"What I claim as my invention, is, securing the palings permanently to the horizontal rods or bars of iron, for the purpose of constructing an entire section of railing, by means of the methods of operating the rods or bars with the palings, having jaws, recesses and bearings, as described herein, and together with other devices in castings, termed saddles, or troughs, having dovetails and tenons cast to them, for the purposes herein named; and this I claim, whether the several parts be formed and adapted to each other, and operated precisely as represented and described, or otherwise, the results always produced being effected by means equivalent to those within named."

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36. For *Improvements in the Steam Engine;* Richard F. Loper, and John W. Nystrom, Philadelphia, Pennsylvania, April 15.

Claim.—"What we claim as our invention, is, 1st, The construction and arrangement of the columns, by which the steam cylinder is connected with the bed frame in such manner that they constitute the air pump and condenser, substantially as herein set forth.

"2d, The method herein described, of actuating the cut-off valve of one steam cylinder, by a motion derived from the valve or valve-rod of the other cylinder, substantially as herein set forth.

"3d, The adjustable supplementary valve *i*, in connexion with the apertures or ports *o*, in the steam valves, by means of which, the steam can be worked at full pressure throughout the whole length of the stroke, without disengaging the cut-off valve."

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37. For an *Improvement in Cooking Stoves;* James S. Marsh, Lewisburg, Pennsylvania, April 15.

Claim.—"Having thus fully described my improvements, what I claim as new therein, is, the apertures *f*, and the passages *n* and *o*, by which the air containing the surplus heat from the oven *b'*, is conveyed to the back of the fire chamber, where it receives an access of heat, and afterwards to the flues *e*, by which arrangement the heat is equalized between the two ovens, and the upper one is ventilated, as set forth."

38. For an *Improvement in Window Curtain Fixtures;* S. S. Putnam, Boston, Massachusetts, April 15.

Claim.—"Having thus described my improvements in window curtain fixtures, I shall state my claim as follows: I do not claim, generally, confining one end of the curtain to the roller on which it is wound and unwound, by means of a groove in said roller, and a confining strip; but what I do claim, is the method or means herein above described of fastening the confining bar in the groove of the roller in which the cloth is pressed; that is, by having the ends of said bar rebated as described, and fitting the caps at the ends of said roller, over said rebated ends of said bar, as above set forth; this arrangement of the caps and bar, (the said caps, or one of them, being loose, so as to move laterally, but not to revolve, the sides of the rebated ends of the bar operating as shoulders to prevent a revolution,) enables me to adapt my improved fixtures to windows of different widths."

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39. For an *Improvement in Setting Logs in Saw-Mills;* John W. Robbins, Camden, Ohio, April 15.

Claim.—"Having thus fully, clearly and exactly described the nature and operation of my invention, what I claim therein as new, is, 1st, the vibrating dog *i*, having the distance of its head or tongue *i'*, with respect to the saw, adjustable laterally, by a set screw *g*, substantially as represented, so that by placing the tongue of the head in each successive curf, and bringing the face of the log in contact therewith, the thickness of each consecutive board is exactly counterpart with the first.

"2d, I claim for analogous purposes, at the rear end of the log, which is destitute of a curf, the vibrating dog *p*, whose distance in respect to the stationary block *g*, is adjustable, by means of a set screw *l*, the range between the head of the dog and the block, affording an easy and determinate means of giving exactly the same thickness to the boards at the rear end of the log."

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40. For an *Improvement in Agitating Grate Bars;* Abraham D. Spoor, Troy, New York, April 15.

"The nature of my invention refers to the use of two separate grates, one of them being made stationary and the other movable, and consists in the application to the movable grate of two separate mechanical movements, viz.: a rocking or vertical vibratory motion, as desired."

Claim.—"I do not claim the employment of a movable grate formed by bars C C, and strips *c c*, the bars C C, working within the bars of the stationary grate; but, what I do claim as my invention, is the application to the movable grate, of two separate mechanical movements, whereby it may receive a rocking or a vertical vibratory motion at pleasure, the several parts constructed and operating substantially in the manner shown and described."

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41. For a *Machine for Cutting Out the Corners and Scoring the Edges of Paper for Boxes;* Andrew Dennison, Brunswick, Maine, April 15; anté-dated April 4, 1851.

"My improvements are applicable to cutting any size of boxes, large or small, square or oblong, or different shapes, if required."

Claim.—"Having thus fully described my machine for cutting boxes, what I claim as my invention, is the combination of the knife and die, substantially in the manner and for the purpose herein described."

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42. For an *Improvement in Apparatus for Operating Window Blind Slats;* Samuel Avery, Phœnix, New York, April 15.

Claim.—"I am aware that cog gearing has been employed for the purpose of operating window blind slats from the interior of a building; I therefore do not claim such device in general.

"But what I do claim as my invention is, making the cog wheel, E, with such a length of teeth, that when its spindle is forced outwards by the spring, they shall engage with the teeth on both sides of the cog wheel F, thereby locking the same and securing the slats in any desired position, substantially as herein described."

43. For an *Improvement in Ornamenting Marble;* Henry Hoffman and Charles F. Hill, City of New York, April 15.

Claim.—"What we claim as ours is the above described ink, and the wax color and etch water used in combination therewith, substantially as described above."

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44. For an *Improvement in Cooking Stoves;* Dennis G. Littlefield, Lowell, Massachusetts, April 15.

Claim.—"My improvement, and what I claim, consists in the peculiar arrangement or manner of combining the fireplace, the descending or diving flues, the ash pit, the lateral chambers, the ascending flues, the central discharge flue, the oven or air-heating chamber, and its surrounding flue space, all as represented in the drawings and as herein before specified."

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45. For *Improvements in the Process of Manufacturing Glazed Sheet Iron;* John Wood and Wm. W. Wood, Conshohocken, Pennsylvania, April 15.

Claim.—"What we claim as our invention, is the employment of thick plates of iron as shield plates, or in other words, the placing four (more or less) thin plates between two shield plates of double weight, in forming packs for rolling, so that each shield plate will make two plates of proper size, to constitute the inside plates of another pack, for the smoothing and finishing process or rolling."

Specification of American Patent.

Specification of a Patent granted to William W. Hubbell, of Philadelphia, Pennsylvania, for an Improvement in Firearms, July 1, 1844; *re-issued March* 11, 1851.

Figures the 1st and 2d of largest size (plate VI.) are copies of the drawings annexed to the original patent, and the 1st and 2d of the smallest size are drawings of the original model gun deposited in the Patent Office, and the third is a semi-sectional view of the breech chamber and the independent adjustable braces thereof. In the drawings, like letters refer to like parts thereof.

Figures 1st and 1st are each a perspective view of the upper part of the breech. To the sides of the back part of the main barrel A, I have two ears B B, through which two rods C C, pass, and are each separately screwed into a breech plate D, which receives the recoil end of the breech E, which contains one load, and which opens on the left hand rod as its centre, the right hand rod acting as its correspondent, and each being movable and adjustable to regulate and determine the joint between the barrel and breech, independent of the other, and both serving the purpose of bracing the main barrel to the breech plate, and having the breech or firing charge between them; thus they form double independently adjustable braces, having the firing charge between the braces; and they secure the barrel and breech in their proper relative position with a more uniform bearing, and better facility to regulate and determine the joint between the barrel and breech, as occasion may require, than has heretofore existed in any breech loading arms, and which feature is very important, so as to be able at any moment to accurately regulate the joint between the breech and barrel to suit either any irregular or uniform expansion of the breech or barrel from heat, or contraction from cold, or clogging of the joint from the refuse of the burnt powder, or wear from use. By screwing up the rod or brace (C or C, fig. 3d,) on either side of the chamber M, and allowing its corresponding brace to remain untouched, the side of the joint nearest the altered brace is tightened, while the other side of the joint remains secured by the other brace, and by unscrewing the brace on either side of the chamber a little, and allowing its correspondent brace to remain untouched, the side of the joint nearest the altered brace is eased, while the other side of the joint remains secured by the other brace. And by uniformly screwing up both of the braces, they uniformly tighten the whole joint. And by uniformly unscrewing both of the braces, they uniformly ease the entire joint between the breech and the barrel. The rods or braces, C C, may be secured to the ears, B B, of the barrel by heads on the rods, as shown on the small figures 1, 2, and 3; or the rods or braces may screw into the ears also, as well as the breech plate, by right and left screws on each rod, as shown on the rod displayed in large figure 2.

This independently adjustable bracing on each side of the firing charge, to regulate and determine the joint on either or both sides of the firing charge between the breech and the barrel as occasion may require, is an important improvement on the efficiency of

breech loading guns or firearms, which have heretofore either had no adjustable bracing, or else the adjustable bracing has been all on one side of the firing charge or joint, or when the bracing may have been double, they have not been independent of each other in adjustability, to alter and determine the joint. There is a percussion tube (G, fig. 1) on the back end of the breech to fire the charge from.

Figures 2 and 2 are each a perspective side view, similar letters referring to the same parts as in fig. 1, to regulate the calibre of the breech E, in its descent to its place properly, with that of the main barrel A. I have screwed or secured to the lower part of the barrel a tongue H, on which the breech rests, and which tongue enters a square groove or mortise on the breech plate D, and it will now be observed that the lower part I, of the breech plate extends under the whole breech, and receives the barrel in a prong, to which prong the barrel is secured by a small tongue on the barrel, having a hole through it slotted longitudinally, fitting into a groove into the base of the prong, through which prong and slotted hole a small screw is passed; these two tongues on the barrel therefore have a longitudinal play in their respective grooves, to permit the adjustable braces to act and regulate the joint between the breech and barrel.

The guard K screws to the lower part of the breech plate; the stock and breech end are secured together by the usual breech tongue and the guard. The back action lock I deem best to use. A flint and steel may be used to fire the charge, the pan being where the percussion tube is. The breech E, may have one or two chambers, a corresponding number always being in the main barrel, and when there are two, a corresponding tube and lock must be on the opposite side. The breech E, may open either on the right or left hand rod, but I have deemed the left hand preferable; a pin L, secures it down.

Operation: the breech E, is opened on its centre, charged, closed, primed and fired, and so on successively.

Claim.—What I claim as my invention is, 1st, the combination of the two independently adjustable braces, extending one on each side of the breech chamber, containing the charge that is being fired, to regulate and accurately determine the joint between the breech and barrel, substantially as described.

2d, I claim the breech opening and closing on an axis, which is parallel to the main barrel, and secured and regulated by the parts, substantially as described.

MECHANICS, PHYSICS, AND CHEMISTRY.

Waste Gases from the Blast Furnace. By David Mushet, Esq.*

The two main defects alleged to have arisen in the attempted economical application of the blast furnace gases, are a diminution of make and an irregularity of working; and it is remarked as strange that these effects should ensue on "the mere fact of using, instead of wasting, the gases escaping at the funnel head after they have entirely *finished their action on the charge.*" This latter assumption is undoubtedly an error; and I have always combatted it. If the gases, at a depth of 6, 8, or 10 feet from the filling place, had entirely finished their action on the charge, it must follow that that additional height to the furnace is unnecessary, and that the furnace would work as well, and make as much iron, if deprived of that extra elevation. Nothing has been more effectually contradicted by experience. The subtraction of so many feet from the top of a furnace has been proved repeatedly to produce marked injurious consequences. An experiment was made at one of the very works enumerated last spring as using the waste gases, by removing 10 feet from the top of one of six furnaces. The effect on the make is well known, and the difference had to be restored. In what way the abstraction of a large volume of heated gas, 8 feet down the furnace, does mischief, is obvious.

* From the London Mining Journal, No. 808.

It is not probable that in ordinary circumstances the ore in that 8 feet is exposed to such a heat as to part with any of its oxygen; but what is more manifest, when upwards of 5 tons of materials per hour, at a mean temperature of 60°, are filled into a furnace, that it must be a matter of no small consequence to deprive this constantly renewed bulk, as it descends, of the action of the heated gases, which ought gradually to raise it to the temperature of that part of the furnace which it is approaching where the deoxidation commences. What is the arrangement which is designated a use of the *waste* gases? A cylinder is inserted into the furnace, 8 feet in depth, into which the cold materials are discharged. The whole heated gas of the blast furnace does not, as in an open top, pass through this body of matter; on the contrary, in those cases where the tube is covered, and described as hermetically sealed, to prevent the entrance of atmospheric air, there is no hot gas passing through it at all. If there is no pressure from without, and the blast to its amount of pressure fills up the cavity underneath the cover, the degree of heat communicated to the cold materials is altogether insignificant; whilst the main volume and current of gas is passing away in another direction. It is, therefore, plain that the detailed arrangements are *not* a use of the *waste* gases. The object of withdrawing the gases at a considerable depth, as explained to me by those engaged in the operation, is to take them in a more heated condition to the boilers; but this is "robbing Peter to pay Paul." The *first* economy must be in the blast furnace; that is the prior consideration in every respect. If the heat taken away from it diminishes the make of iron, with a given quantity of coke, (only 10 tons weekly, much more if 30 tons, which is the effect recorded,) the saved coal of the boiler fires is indeed the gain of a very great loss. The first point for attention must be to use *actually* the *waste gases;* and for this end they ought to be in reality drawn off "after they have finished their action on the charge." If after they have done this, and passed through the materials to communicate the necessary heat, they are then found too cold to inflame effectually under the boiler, that is a distinct consideration. This difficulty must be encountered on its own merits, and be overcome if it can; but the power of the furnace is a separate and more important question, which must be preserved intact. In tampering with this, there can be no economy. I consider, therefore, that the depriving the furnace of a part of its useful gases is one main cause of the diminished make. Another cause will be explained by my remarks on the 14th October on the effects of a wide filling place. In whatever degree the arrangements for removing the gas obstruct the free passage of the blast outwards, they will insomuch produce the same effect as narrowing the filling place. If the area of the conducting pipe and flues were equal to the unobstructed area of the top, the blast would not even then have so free a passage. The obstacle presented by the cover, and the impulse destroyed by the lateral angle at which the gases escape, would neutralize the effect of even a high velocity in the conducting tube, induced by the draft of the boiler chimney. But I have understood that every thing approaching to an exhaustion of the gas, which would bring atmospheric pressure into play, and endanger the entrance of air through the cover, is carefully

avoided. It is, therefore, plain that, in conducting the gas to the boiler by a tube of 3 feet square, which I have been told is used, there must be a great check to that rapid action which gives so much advantage to a large filling orifice.

The second alleged evil is scaffolding, and the irregularities of working which are entailed by that most noxious disease. Scaffolding has its origin in a destruction, or disturbance, of the equilibrium of the descending materials, which should preserve an equal uniform motion from every side towards the centre over the hearth, where the power of that motion is constantly acting. The action of a blast furnace, with properly formed boshes, is very exactly exhibited by the descent of the sand in a sand-glass. The form which the sand assumes in its descent by the continuous abstraction at the orifice beneath, is a picture of what is proceeding in a regularly working furnace. If by any means an obstruction is formed vertically over the hearth, the equilibrium of descent is destroyed. The blast has to force its way at the weakest lateral point. An irregular unbalanced channel of fusion and descent is established, affecting the materials partially instead of centrically. As the central obstruction is gradually worn away, the bulk of partially heated materials press upon it as they pass over to the lateral channel; and, when sufficiently weakened, then comes a slip, which probably fills up entirely the false channel of fusion, forcing the blast to drive a passage in an opposite direction, and perhaps diverting this heating agent, which ought to be concentrated, into several lateral detachments. The materials which have been brought into semi-fusion in the false channel, are suddenly chilled and agglutinate, forming often a permanent shelf attached to the side of the furnace, perpetuating irregularity of action; one evil leading to another; so that it is very well known, in cold blast furnaces especially, when scaffolding by some accident has been established at first starting, that the furnace has often never righted itself until blown out. Now, I should say beforehand, (and this is what I expected to hear some account of,) that it would hardly be possible to devise a more certain means of destroying the working equilibrium, and establish scaffolding, than to find a mass of cold materials in the centre of the furnace; and, by withdrawing the gases at the sides, *keep them* proportionally *cold* as far down the furnace as possible, favoring at the same time in every way the *lateral* passage of the blast upwards; and, where the gas is drawn off at one side only, tending to maintain an oblique channel and current towards that particular side. I have not found that the effects of the manner in which a blast furnace is filled upon its regularity of action, are by any means so fully recognised and considered as the great importance of the subject deserves. You will find, in conversing with experienced furnace managers, that some of them are aware that a greater heat may be obtained in a given part of the hearth by filling a greater proportion of coke at the top vertically over that region; but a thorough appreciation of its consequences, and its reduction to a system of regular practice, I have been unable to trace further than to the eldest of two brothers of the name of Broad, managing Mr. Crawshay's furnaces at Cinderford, and Mr. Booker's at Pentyrch. I always make a point of naming the originator of any improvement, as far as I know it; for I am sorry to say it is but too much the fashion not only to appropriate the

ideas of others without acknowledgment, but even to wrap them up in a *colorable variation*, so as to make them, if possible, appear original—a course of confusion which is quite unpardonable. There are, I fear, quite as many pirates of ideas as of patents; and I should equally shudder to be identified with either class of dishonesty. The principle to which I refer, and which is absolutely essential to the successful use of refractory ores with hot blast—the lesser penetrative intensity of which gives it an especial tendency to the sides of the furnace rather than to the centre—is to fill the ore and fluxes in a ring round the sides, leaving the centre of pure coke. What might be the effect of this arrangement with cold blast, where the nature of the materials is to work very cold at the tuyère, I have not seen tried; but the principle in itself is so sound for maintaining the central action of heat, and the equilibrium of descent, that I have no doubt it might, with proper modifications beneath, be rendered most beneficial, even in such cases where the character of the materials demand it least as a *necessary* practice. By the fruits of it, in my own experience, I consider it impossible to over-value the importance of the principle. By the present mode of filling through the tube, the materials are delivered into the body of the furnace in a conical heap; so that for at least 2 feet further down than the aperture of delivery—that is, to a depth of 10 feet—there will be no mine or materials of any sort against the sides of the furnace; and the materials which find their way there will be the largest fragments of coke or ore, rolling down the sides of the cone. All the small mine coke and dust will remain aggregating in the centre, forming a dense impervious column over the hearth, obstructing effectually the vertical ascent of the blast; whilst the open texture of the mass accumulating towards the sides will give the greatest facility for its ascent in that most improper of quarters.

These, then, are the causes of the alleged evils, and which will be developed in different degrees, according to the nature of the materials:—1. That the gases withdrawn are not the waste gases. 2. That the vent of the blast is checked, and the same diminution of working generated as arises from a narrow top; for it is distinctly explained that the gases are not drawn off, but only diverted into a smaller channel. Were they actually drawn off—that is, taken from the furnace by an exhaustion which created atmospheric pressure—that could have no other effect, so long as the coverings were air-tight, but to induce a more ready entrance of the blast, causing the furnace to drive faster and make more iron. The cause of the third evil, the scaffolding, is the mode of filling. This is the principal defect; and the arrangement for the cure of this will include to a certain extent the cure of the others.

To be Continued.

On the Use of Caustic Lime, Instead of Limestone, in Blast Furnaces. By George Parry.*

The results obtained at the Ougrée furnaces by the use of quicklime, in lieu of limestone, are very striking; and the continued success attending its use seems now to have fully established its superiority. One of the

* From the London Mining Journal, No. 807.

causes assigned is the absence of the cooling effects, at a low region of the furnace, from the absorption of heat by the carbonic acid during its change of state—from the solid to the gaseous. In furnaces using so large a proportion of limestone as 21 cwts. to the ton of iron, as at Ougrée, the effect on the temperature from that cause must be considerable, and tend to narrow the zone of fusion, thereby diminishing the power of the furnace in melting a certain weight of prepared material in a given time —that allowed for the combustion of a determinate quantity of fuel. Besides this, the presence of carbonic acid, as an oxidizing agent, is highly objectionable in that part of the furnace depended upon for the reduction of the ores; for, as it is well known, iron at a high temperature possesses the power of decomposing it by abstracting a portion of its oxygen. Again, if the ascending current of gas is really converted into carbonic oxide by contact with the superincumbent incandescent coke, its volume will be doubled, and its capacity for heat increased—hence another source of frigorific influence on the furnace. Messrs. Bunsen & Playfair, (*Report on Iron Furnaces, British Association*, 1845,) however, do not show that any such change takes place during the passage upwards; and their experiments were conducted with the most scrupulous regard to accuracy. The gases were taken from a furnace fed with bituminous coal, but only 36 feet high. Possibly the superior height of the furnace at Ougrée, 54 feet, together with the circumstance of its being supplied with coke, proved the means of subjecting the gas to a higher column of incandescent carbon, and thereby have effected the change.

Ebelmen, on the contrary, gives an *increase* of carbonic acid in the upper part of the furnace; and the analyses quoted in Overman's work are in the same predicament. From these discrepancies it will be interesting to have the promised details of the examination of the gases made at Ougrée. Little attention seems to be paid to the preparation of the materials supplied to furnaces, with the exception of the ironstone—every furnaceman dreading the use of it imperfectly calcined, well knowing from experience the inability of the furnace to smelt it in the usual proportions. Yet it has passed through the kiln, and all its moisture has evaporated. What, then, can be the cause of its injurious effects on the action of the furnace? The presence of carbonic acid, with which the oxide of iron is combined, the calcination not having been carried sufficiently high to expel it. The question of temperature at the zone of fusion, also, is generally confined to what can be done in its *immediate locality*, by applying blast as hot as can be obtained with safety to the heating apparatus—it requiring too great a stretch of the imagination to conceive how a slight difference made at so distant a point as the mouth of a furnace can possibly affect its temperature at bottom. Such, however, is the fact; and one-half of the benefits conferred by the application of heated air may be easily nullified by inattention to this particular. It is not quantity of heat that we want in a blast furnace—it is *intensity*, sufficient to create a more active play of chemical affinities in the laboratory of the furnace, and a more rapid and complete dissolution of the reduced minerals in the zone of fusion before they reach that of combustion, and become re-acted upon by the oxygen of the blast.

In order to forward this desirable state of things from above, it must be considered that the temperature of the descending materials at any

given point is always in *arrear* of that of the ascending current of heated gases, and will become *more so* the greater the quantity of volatile matter they contained at their introduction, whether that may be of a nature to become dissipated before they arrive at a state of incandescence—such as moisture—or after having passed that point, as the gaseous and other matters evolved during the distillation of coal, and the carbonic acid from uncalcined carbonates. The effect of these combined cooling influences is to allow the minerals, before they have attained a certain determinate temperature—say, that necessary for deoxidation or fusion—to be carried to a lower point in the furnace than otherwise would be, had they not existed. Thus the zone of fusion will have become reduced in breadth, and insufficient for performing its functions without encroaching on the zone of combustion below, with all its attendant evils—scouring cinder with loss of iron, bad yields, and inferior quality.

This is not all; the supply of fuel also reaching the blast at a correspondingly reduced temperature, is now unable to give out so great a degree of heat by its combustion; and this diminution goes on increasing for some time, till an equilibrium is established. The modern domed-form of blast furnace with a wide mouth, in a great measure counteracts the above defects, by effecting the absorption of more of the heat of the ascending current of hot gases than can be obtained by the old conical narrow-topped furnace; for at a certain limited depth the capacity of the former will be found fully double that of the latter; consequently presenting twice the surface of minerals to the action of the gases. These, also, in passing through this enlarged region, move with only half the velocity, and, therefore, give double the time for the abstraction of their caloric. Hence it follows that by *doubling* the capacity of a furnace at the upper parts, or where the transference of heat goes on with the greatest rapidity from the continued influx of cold materials, *nearly four times* the amount is collected and carried down by the descending masses. That narrow tops consume a great deal of fuel, is an old and general complaint; and possibly the above considerations may afford an explanation of the cause.

The theory of *conduction* upwards cannot be admitted—there not being the slightest analogy between the transference of heat from the bottom to the top of a furnace, and from one end of a bar of iron to the other. The latter is a good conductor of heat while the furnace is filled with bad ores. It would take months to convey the heat through such a disintegrated mass by conduction alone; while the passage of the gases effects it in a few seconds. Practically, the heat would never reach the top by conduction; it would be dissipated by radiation from the sides of the furnace faster than the loose matter in its interior would take it by conduction.

Ebbw Vale Iron Works, Jan. 30.

On the Use of Caustic Lime, Instead of Limestone, in Blast Furnaces. By Thomas Howells, *Furnace Manager.**

The frequent, almost weekly, observations in your valuable paper upon the use of lime, instead of limestone, in the blast furnaces, induce me to

* From the London Mining Journal, No. 810.

furnish you with particulars of the use of lime for a long period upon our blast furnaces at Abersychan—the result of which may be fully relied upon. In August last, our manager, in order to work off some limestones of an inferior quality, and condemned as useless, instructed me to burn some of them in one of our idle kilns, and then to use them in the furnaces in the form of lime. I commenced putting the lime into No. 7 furnace, one charge out of four, and gradually replaced all the limestones by lime. My burden of limestone for iron of good quality was 4 cwts.; I now use of lime 2 cwts. to the charge; and my furnace "burden" has borne an increase, without deterioration in the quality of iron produce, of from ¾ cwt. to 1 cwt. to the charge.

On our No. 3 furnace, I use 1¼ cwt. of lime where I used to require 3 cwts. to the charge of limestone; and the furnace burden is increased in proportion. I find the furnaces work in every way satisfactorily since the application of the lime, and do not observe that the use of lime in any way prejudices the quantity or quality of iron which they produce.

Abersychan, Monmouthshire, Feb. 26.

For the Journal of the Franklin Institute.

A Series of Lectures on the Telegraph, delivered before the Franklin Institute. Session, 1850-51. *By* Dr. L. Turnbull.

Continued from page 274.

Application of Galvanism to Telegraphing.—"Mr. S. T. Sömmering, of Munich, first applied galvanism to telegraphing; in 1809, he constructed an apparatus, which by decomposing water enabled him to give signals. At the station where the news was to arrive, were arranged thirty-five small glass test tubes, filled with water, and reversed in a reservoir also containing that fluid. Into each one of these test tubes, projected through the bottom of the reservoir the gilt end of one of thirty-five wires, that came from the transmitting station. Each wire at the termini of the line was connected to its own distinct brass plate or cylinder. These plates were arranged in a row and perforated at one extremity; by introducing two conical metallic pins connected with the poles of a voltaic battery into these perforations, a circuit was established. Each glass tube was marked with one of the 25 letters of the German alphabet, or 10 numerals, and the plate connected to it by wire at the other station, was stamped with the same. The circuit being established, the water in two of the tubes was decomposed, the gaseous constituents of which rising gave two signs, whose succession was determined by considering the letter over the evolved hydrogen as first. Decomposition of water gives twice the volume of hydrogen that it does of oxygen, and thus no mistake could well be made in distinguishing them. The conducting wires, well insulated, after passing some distance from the apparatus, were wound into a rope to go on to their destination. Fig. 3 represents Sömmering's telegraph; A A water receiver. The points protruding into it are shown, the glass tubes are removed. B B the apparatus to close the circuit; C the voltaic battery; single wires coming from the wire rope D have connexion with the plates or cylinders. Into the perforations of these plates the metal pencils connected

with the closing wires X *y* fit exactly; they are kept clean and free from oxidation in order that they may do so.

If the rod or pencil of the positive pole is put into the plate L, and that

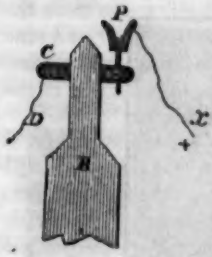
Fig. 3.

of the negative one into the plate S, the circuit is closed. Coming from X, the current goes into the wire in connexion with L, then to *i*, at the other station, through the receiver to S, thence into the conducting wire to S at the first station, through *y*, to the negative pole of the battery.

Oxygen rises from the positive pole in the glass *i*, and hydrogen from the negative one in the glass *s*, and thus a signal is given which reads *s i*.

The mode of completing the connexion is exhibited in the small fig. 4, by a lateral view of the instrument; B standard to support the frame of cylinders; C a single cylinder; *a* orifice in it where the rod P is introduced; *x* wire connecting with the positive pole of the battery; D wire leading to the opposite station.

Fig. 4.



Especial signals are used to denominate the same letter used twice in succession, or to designate the end of a word. Sömmering connected with his instrument a curiously constructed alarm, to call the attention of the operator. It consisted of a two armed lever, the longer arm having the shape of a spoon, while the shorter supported a rolling brass ball. The arrangement was easily moved, and it was necessary to poise it after each telegraphic operation. The hollow end of the long arm stood over the end of one of the wire points, and at the commencement of an operation received the hydrogen that was evolved at this point. After one half a minute, sufficient gas was evolved to carry upward in its ascent the long arm of the lever, depress the shorter one, and by this depression permit the ball to fall through a tube on a lever connected to an alarm stop, set it loose, and thus put the alarm in active operation. Though very ingenious, the expense of so many wires, and their insulation, precluded the use of this instrument on a large scale; likewise, the necessity of constant attention on the part of the attendant to watch the evolution of gas in two of the thirty-five tubes, was a strong objection to it.

On the publication of this apparatus in his Journal, Schweigger proposed the use of two wires, which he considered sufficient, if two voltaic batteries, one strong and another weak, were used, and the time being taken into consideration partly during the evolution of the gas, and partly that which elapsed between the two evolutions following each other.—(*From the German of Dr. H. Schellen, &c., p.* 53.)

We find the following in *Thompson's Annals* for 1816, from the pen of Dr. J. R. Coxe, then Professor of Chemistry in the University of Pennsylvania. This hoary headed veteran in the cause of knowledge, is still living in our midst. Though long since withdrawn from the active duties of teacher in the oldest medical school of this country, the mementoes of his labors remain emblazoned among the records of science. Speaking of galvanism, he says, "I have contemplated this important agent, as a probable means of establishing telegraphic communications with as much rapidity, and perhaps less expense, than any hitherto employed. I do not know how far experiment has determined galvanic action to be communicated by means of wires; but there is no reason to suppose it confined as to limits, certainly not as to time. Now, by means of apparatus fixed at certain distances, as telegraphic stations, by tubes for the decomposition of water, metallic salts, &c., regularly arranged, such a key might be adopted as would be requisite to communicate words, sentences or figures, from one station to another, and so on to the end of the line. As it takes up little room, and may be fixed in private, it might in many cases of be-

sieged towns, &c., convey useful intelligence with scarcely a chance of detection by the enemy. However fanciful in speculation, I have no doubt, that sooner or later, it will be rendered useful in practice. I have thus, my dear sir, ventured to encroach on your time with some crude ideas that serve perhaps to elicit some useful experiments in the hands of others. When we consider what wonderful results have arisen from the first trifling experiments of the junction of a small piece of silver and zinc in so short a period, what may not be expected from the further extension of galvanic electricity! I have no doubt of its being the chief agent in the hands of nature in the mighty changes that occur around us."

Next in order of those depending on the galvanic principle solely, is the physiological telegraph of Vorzleman De Haer. He proposed the instrument on a small scale in 1839, basing it on the property of galvanism to produce physiological effects on the nerves and muscles, and making sensation the means of receiving the signals. He was compelled to use ten wires after Messrs. Steinheil and Morse had succeeded with only one, and experience has also taught us that many repeated shocks render the operator insensible; the workmen in the gutta percha manufactory of Fonropert and Pruckner, at Berlin, engaged in proving insulated tubes, lose sensibility in their hands and forearms after a day's work. One constructed by a skilful organ builder, was exhibited in January, 1839, at a sitting of the Physical Society of Deventer. The keys have a similar arrangement to those of the piano forte, and connexion is established by depressing them into a cup of mercury; no extensive use has been made of this instrument.—(*From the German of Dr. H. Schellen, &c., page* 66.)

Mr. R. Smith, Lecturer on Chemistry, Blackford, Scotland, invented an Electro-Chemical Telegraph. A paper containing an account of which was read before the Royal Scottish Society of Arts, on the 27th of March, 1843, reported on by a committee, and approved the 12th June following. Since that time, many trials have been made, and various improvements in its construction have also been introduced by the inventor. The following is a description of it in its present improved form.

In the annexed wood-cut, A represents the indicating portion of the telegraphic apparatus, *a* is a leaden cylinder fixed upon a spindle, which is supported so as to revolve freely, by two standards attached to the bottom plate of the apparatus, *b b* is a piece of calico in the form of a ribband coiled upon the roller *c*, placed in the trough *d*, its contrary extremity being attached to the second roller *e*, revolving loosely in standars attached to the opposite end of the bottom plate, B is the communicator, or that portion of the apparatus through which any given signal is communicated to the indicator A; *f* is a block of wood having a brass plate *g* attached to it, *h* is a slip of wood hinged to the block, and slightly raised above the surface of the brass plate *g* by means of a spring placed beneath it. The brass plate *g* is connected by the wire *k* with the positive end of the voltaic battery C, the negative end of which is connected with the wire *l*, which passes along to the indicator A, where it is attached to the leaden cylinder *a*. The other wire *m* is attached to the finger-board *h*, through which it passes, projecting slightly on the lower surface, its contrary end being attached to the impress wire *n*, which is supported loosely by a cross-beam on the top of the centre-standards of the indica-

tor, its lower end resting upon the calico ribband on the leaden cylinder beneath.

To put this apparatus in action, the cells of the battery C are filled with water, and the trough *d* with a solution of ferro-cyanate of potass, to which have been added a few drops of nitric acid. The roller *e* to which the indicator cloth is attached is next put in motion by clock-work, and thus the cloth wet with the solution contained in trough *d* is caused to pass uniformly over the leaden cylinder *a* below the point of the impress wire.

The apparatus is now ready for signaling, which is done by pressing down the finger board *h*, so as to bring the end of the wire *n* in contact with the brass plate *f*, thus completing the electric circuit. The impress wire *n* now becomes the positive electrode, and the cylinder *a* the negative one, and a blue mark is printed upon the cloth, by the electric fluid decomposing the ferro-cyanate of potass, thus forming cyanate of iron. If the circuit is formed and broken rapidly, a succession of dots will be printed upon the cloth; if formed and broken at long intervals, the result will be a series of marks. In this manner long and short spaces and corresponding lines will be formed according to the duration of the opening or closing of the circuit, and the speed with which the cloth is caused to pass beneath the metallic pen. An arrangement of these various marks thus forms the telegraphic alphabet, from which sentences may be composed, embracing any information which it may be necessary to transmit. For instance, a single dot may be taken as the index for A, two for B, three for C, and a dot and line for D, &c.

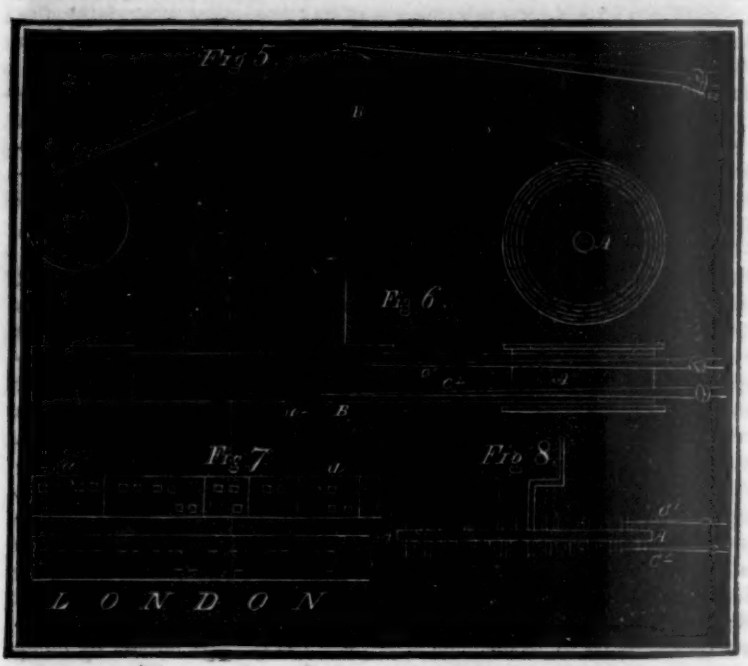
The species of battery which is the best adapted for producing the electro-chemical indications, consists of 40 repetitions of charcoal and zinc plates; the charcoal plates being composed of three parts pulverized charcoal, two of pulverized coke, and one of wheaten flour, mixed together with water; when formed, the plates are allowed to dry, and are then placed in an earthen crucible, in the lid of which is an aperture for the escape of the gases; in this they are heated to redness. This battery will keep up a uniform and energetic current for a considerable time, the cells being merely filled with water; the only attention which it requires subsequently, being to wash off any oxide which may be deposited upon the plates, and supply fresh water. The battery employed for making the electro-magnetic telegraph is a calorimoter or single circle, the electricity generated by this battery has a tendency to weaken in its progress,

so that the defect must necessarily be provided for by placing batteries at different distances, according to the desired amount of power, this objection is completely removed in the voltaic apparatus. Experiment has proved that the electric energy from the intensity battery, in producing the electro chemical effects, *increases* instead of diminishing in regard to distance. Faraday ascertained that the quantity of electricity required to decompose a single drop of water, is equal to that of a powerful flash of lightning, while from the largest single circuit ever constructed, not the slighest chemical effect can be exhibited. On the other hand, a small single circle composed only of a few square inches of copper and zinc, will temporarily magnetize a large bar of iron, while a powerful voltaic trough will not magnetize a lady's sewing needle. Throughout the whole of the practical details of the electro-magnetic apparatus, a far greater amount of carefulness of workmanship is required than in those of the voltaic one. Thus, the whole of the joinings of the conducting wires, require to be in perfect metallic contact, and carefully isolated, whilst the electro-chemical communications may be transmitted through the medium of a wire fence. The inventor lately exhibited an experiment which proves the practicability of this application.

In this case the communicator and indicator were attached to the contrary extremities of an iron wire fence of a length of 1868 yards, when a number of signals were despatched with the greatest facility. This economical adaptation will doubtless render it worthy of the attention of railway proprietors, as a metallic fence may in this manner be rendered doubly useful.—(*Prac. Mech. and Eng. Mag., Glasgow, Vol.* I., *2d series, pp.* 36, 239.)

Succeeding this in our chronological series, comes the instrument of Alexander Bain, a native of the northern part of Scotland. Mr. Bain's instrument, dated December 12, 1846, in patent specifications, depends for its efficiency on electro-chemical action, and consists of a transmitting apparatus at one end of the line, with a recipient one at the other terminus. Figure 5 is an elevation, and fig. 6 is a plan of so much of a transmitting apparatus as is necessary to show its mode of action. A A is a thin roller of wood upon which is wound a long strip of paper, previously perforated with holes *a a a*, in the manner represented in fig. 7. Each group of holes as divided by cross lines, represent letters, numerals, words, or sentences, as may have before been fixed upon. From this roller A, the end of this slip of paper is passed between another roller B, and two metallic springs C^1 C^2. The roller B is composed of metal pieces a^1 a^2, mounted upon wood inside, so that their contiguous edges shall be some distance apart; and the roller is moved by clock work, whose velocity is regulated by a ball governor. The receiving apparatus at the other end of the line is the same as the transmitting one, except, that instead of the strip of perforated paper, there is wound on the roller A A, a strip of colored paper. This is first soaked in diluted sulphuric acid, and afterwards in a solution of prussiate of potassa; while wet it is wound on the first roller A, where it forms part of the galvanic circuit, and must be kept damp while the message is being sent. When the machines at both ends of the line are thus arranged, and connected together by wire, with the metallic springs C^1 C^2, attached to a galvanic battery, the operator at the transmitting end sets it in motion,

like the lock which governs the striking of a clock; this lifts a detent in the receiving apparatus at the other end of the line, and puts that in operation. Thus, the two machines unroll their strips of paper at the same time, and as long as the contact between the springs C^1 C^2, and the second roller B, of the transmitting machine, is prevented by the paper which has no holes in it passing between them, the circuit is broken. As soon as the spring C^1, comes over one of the holes in the paper, the circuit is re-established, and the electric current flowing through these holes, passes along the connecting wire to the wet roll of paper at the receiving end of the line. The electricity passing through the wet paper destroys its color by chemical action in those parts which it enters, and thereby makes as many legible spots on the wet roll of paper, as there are holes in the dry roll at the other end of the wire. Thus, by alternately renewing and breaking contact by means of the holes in the transmitting roll, as many corresponding letters, numerals, &c., are made on the receiving roll.



An exemplification of the alphabetical characters employed by Mr. Bain, is given in fig. 7, which represents at once the perforations which would be made in the transmitting paper, and the corresponding marks which would be made in the colored or recipient paper to express the word LONDON. When it is desired that the attendant at the receiving station should not know the contents of the message sent, the receiving roll is wet in diluted acid, passed through the machine, and afterwards immersed in the solution of prussiate of potassa, which makes the words plain. The holes are made in the paper by means of a separate machine worked by hand; the

paper passes between two rollers, one of which is a small punch, which cuts the holes in the paper, and works by the slightest touch. After the holes are made in the paper, it then has to be wound on the transmitting roller. The rapidity of this mode of communication depends on the number of holes which a clever hand can punch in a given time, which is about 100 per minute; after the holes are made, the machine will transmit from 500 to 1000 impressions in a minute. Mr. Bain has lately remodeled this machine, by changing the rollers of the receiving apparatus into a revolving disk, in the periphery of which, there are a number of metallic rods or wires of equal length, which may be made to slide towards one side of the disk, or the other, at pleasure.

Fig. 8 is a plan of this modification. A is the edge of the disk; *b b* the wires; and C^1 C^2 springs, similar to those marked with the same letters in other figures. It will be obvious, that when the disk A is made to rotate, the springs C^1 C^2 will successively be brought in contact with the wires *b b*, on one side or on the other; and that as they are made the means of establishing the metallic connexion between the two ends of the line of communication, the effects produced upon the chemical substance will be the same as before described. In this case, the wires *b b* serve the purpose of the holes in the strip of paper, fig. 7.—(*London Mechanics' Magazine, Vol.* XLVI. *p.* 591.)

"In this form of telegraph," he remarks, "I have rejected magnetism altogether, and caused the pulsations of the electric current to be transmitted through groups of perforations, forming signs, which are recorded at the receiving station by pulsations of the electric current acting on chemically prepared paper, in the manner described and shown; so that the circuit is completed, and interrupted, by the operation of the composed communication itself, without the electric current having to produce any mechanical motion, and without any manipulation of the operator, in forming the intermittent pulsations of the electric current; thereby effecting the transmission of a communication to one or a plurality of distant receiving stations, with far greater rapidity than by any other mode."

This may be true in theory, but it will require more time than the simple passage of the current in practice. For in every case decomposition of the fluid will take place, and time is required for the operator to see the mark. If the paper should become dry, as it is known to do, the mark then becomes very indistinct from the want of proper conducting material; and as the wire is not of platinum, by becoming oxidized it prevents that proper metallic contact, so that it will require an intense and constant current, which cannot be produced and kept up in the form of battery described by Mr. Bain, namely, zinc and copper battery. There is also the inconvenience arising from the fumes from the chemicals employed in preparing the paper.

S. F. B. Morse's Electro-Chemical Telegraph, Patented in May, 1849. —"The nature of my invention consists: First: In the application of the decomposing effects of electricity produced from any known generator of electricity, to the marking of the signs for numerals, or letters, or words, or sentences, invented and arranged by me, and secured by patent, bearing date June 20th, 1840; re-issued January 15th, 1846, and again re-

issued, June 13th, 1848, or their equivalents, through a single circuit of electrical conductors.

Second. In the mode of applying this decomposition, and the machinery for that purpose.

Third. In the application of the bleaching qualities of electricity to the printing of any desired characters.

In applying the decomposing effects of electricity upon any known salts that leave a mark, as the result of the said decomposition, I use,

Class A. A class of salts that produce a *colored mark* upon *cloth, paper, thread* or *other material*, under the action of electricity.

First. Iodide of tin in solution.

Second. Extract of nutgalls, and sulphate of iron in solution, making an ink which colors white cambric cloth a uniform grey.

Third. Acetate of lead, and nitrate of potash in solution.

Fourth. Iodide of potassium in solution.

Into either of these I dip a strip of cloth or thread, which is kept properly moistened. All these give a black mark upon the cloth, thread, or other material under the action of electricity.

Class B. A class of salts which color the cloth, paper, thread, or other material, and are *bleached* by the action of electricity.

First. Iodide of tin in solution.

Second. Iodine dissolved in alcohol.

Into either of these I dip a strip of cloth, paper, thread, or other material; and if in solution *second*, I also dip them into a solution of sulphate of soda, the cloth or other material, in these cases, becomes of a purple color more or less dark. The electricity in these cases, when a metallic point or type is pressed upon, or comes in contact with, the moist cloth or other material, *bleaches* it, and leaves the point or the type impressed in white characters upon the material.

Class C. A class of salts that produce a mark upon metal, through the intervening cloth or other material, and not upon the material, under the action of electricity.

First. Sulphate of copper in solution.

Second. Chloride of zinc diluted with water.

Third. Sulphate of iron in solution.

Into either of these solutions I dip the cloth, thread, or other material, and if into the third, I afterwards dip it into muriate of lime in solution. The electricity in these cases causes a dark mark upon a bright metal plate beneath the moistened material, but not on the material itself.

The mode of applying this decomposition by electricity, is by the use of so much of my machinery previously described in the schedule referred to in the Letters Patent, granted to me and bearing date June 13, 1848, being the re-issue of the original patent of April 12, 1846, as is employed in regulating the motion of the paper, substituting, however, for the common paper therein used, the cloth, thread, metal, or other material, chemically prepared.

Operation.—I consider the discoloring process better than the bleaching process, and for the discoloring process I consider the iodide of potassium in solution, as the best of the substances I have mentioned for the preparation of the cloth, paper, or other material. I wish it to be understood that

I do not confine myself to the use of the substances I have mentioned, but mean to comprehend the use of *any known substance already proved to be easily decomposed by the electric current.*

The marking instrument of Morse is a platina disk, and is described fully in the patent. As this apparatus has not been used practically, I have noticed it here more to keep up the chain of Galvanic Telegraphs, and I am surprised that Mr. Morse should have taken out a patent for a telegraph so far inferior to the one he has in operation since 1840, as there cannot be a doubt that the Chemical Telegraph, according to the opinion of the best operators, is far inferior to the Electro-Magnetic in regard to trouble, expense, and uncertainty in operation.

Claims. What I claim as my own invention and improvement, and desire to secure by letters patent, is, 1st, the use of the *single circuit* of conductors for the marking of my telegraphic signs already patented, for numerals, letters, words, or sentences, by means of the decomposing, coloring or bleaching effects of electricity, acting upon any known salts that leave a mark as the result of the said decomposition, upon paper, cloth, metals, or other convenient and known markable material.

2d, I also claim the combination of machinery as herein substantially described, by which any two metallic points or other known conducting substances, broken parts of an electric or galvanic circuit, having the chemically prepared material in contact with and between them, may be used for the purpose of marking my telegraphic characters already patented in Letters Patent, dated 20th of June, 1840; in the first issue, 25th January, 1846; and second re-issue, 13th June, 1848."

SAMUEL F. B. MORSE.

"The last patent of Mr. A. Bain, is one taken out in connexion with Robert Smith, Lecturer on Chemistry, Perthshire, Scotland, October, 1849.

"These improvements consist—

Firstly. In the peculiar mode of arranging the several parts herein described of our marking instruments of Electro-Chemical Telegraphs.

Secondly. In a mode of constructing a style or point holder, so as to afford a ready and convenient mode of regulating the pressure of the style or point on the surface of the chemically prepared paper or other suitable fabric.

Thirdly. In a mode of applying a weight for regulating the pressure of an upper on a lower revolving wheel, or roller, in motion, so as to grasp the strip of chemically prepared paper, or other suitable fabric, and ensure it being drawn continually forward.

Fourthly. In a mode of arranging the marking instruments, keys, wires, and batteries, in a single circuit, and in branch circuits, connected therewith, so that a copy of a message sent from any station may be marked upon the chemically prepared paper, or other fabric, at any desired number of stations in communication therewith, and also, if required, at the transmitting station.

We would here state, that the paper, linen, or other suitable fabric, may be prepared by being equally and thoroughly moistened by the following chemical compound, viz.: Ten parts, by measure, of a saturated

solution of prussiate of potash, which will be best made in distilled water, and we prefer to use the yellow prussiate for this purpose; two parts by measure of nitric acid, of the strength of about 40° by Baumé's scale; two parts by measure of muriatic acid, of the strength of about 20° by Baumé's scale.

To keep the paper, or other fabric; in a sufficiently moist state, favorable for the action of an electric current, we add about one part by measure of chloride of lime; this mixture is to be kept stirred about with a glass rod until the chloride of lime is in complete solution. In connexion with this compound, it is proper to observe that we have found that prussiate of potash, combined with almost any acids, will give mark under the decomposing action of an electric current, but no other mixtures act so quickly, or give such permanent marks with feeble currents of electricity, as that herein described. The principal use of the chloride of lime is, that it absorbs moisture from the atmosphere, and thereby keeps the prepared fabric in a proper state to be acted upon by an electric current in all states of the weather."

"The system of correspondence made use of consists of *dots* and *lines*, the number, dimensions and relative positions of which form an intelligible code of signals, as is well understood.

We do not claim as our invention the train of wheels constituting the motive part of the marking instruments; neither do we claim or confine ourselves to any particular form of battery or other generator of electricity, which may be of any suitable form, several of which are well known and in common use.

We desire it to be understood that what we claim as new and of our invention, is—

Firstly. The modes of arranging the several parts of our marking instruments for Electro-Chemical Telegraphs, substantially as herein before described.

Secondly. We claim the mode of adjusting a style or point holder, as herein before described and shown, so as to afford a ready and convenient mode of regulating the pressure of the style or point upon the surface of chemically prepared fabric.

Thirdly. We claim the mode of applying the weight Q, for the purpose of regulating the pressure, as herein described and shown.

Fourthly. We claim the mode of arranging the marking and transmitting instruments, wires and batteries, in a single circuit, and in branch circuits connected therewith, so that a copy of a message sent from any one station may be marked upon chemically prepared paper, or other fabric, at one or any desired number of stations in communication therewith, and also, if required, at the transmitting station, without requiring the use of any secondary current."

On the 28th of May, 1850, Messrs. Westbrook and Rogers, the former of Washington, the latter of Baltimore, secured a patent for the "Electric Metallic Telegraph." In their specification they state that:—The nature of our invention consists in recording telegraphic signs on a metallic surface, connected with the earth by a wire conductor at one end, and to a galvanic battery and the earth at the other end of the circuit, by the use

of the acidulated water or other fluid interposed between the point of the usual wire conductor leading from the operating apparatus, connected with the galvanic battery of the ordinary construction and the metallic surface, by which the use of paper is dispensed with; time also being saved in not having to moisten the chemically prepared paper, when it becomes too dry for use, and in having the telegraphic signs more clear and distinct on the metallic surface than on the paper; in avoiding the inconvenience arising from the fumes from the chemicals employed in preparing the paper, and evils arising from the corrosion of instruments, and annoyance to operators in preparing and using chemical paper, and other inconveniences.

The metallic recording surface, after being filled and transferred, is simply cleaned by the application of a sponge or other soft substance saturated with acidulated water. The wire conductor has the form of a tubular pen, of which the fluid flows by means of a barrel valve or sponge and porous substances, such as glass or ivory, open at both ends, through which the acidulated water or other fluid passes to the metallic surface, on which the telegraphic signs are to be made.

To be Continued.

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*Hadrot's Moderator Lamp.** (*With a plate.*)

The reign of gas has not quite brought about the extinguishing of our old principle of portable lights, if we are to take the number and variety of modern oil and candle lamps as any thing of a criterion. There are, it appears, still many uses for the oil lamp, and quite enough to stimulate invention for its improvement. In France, where the introduction of gas has been more slowly developed than with us, a great amount of talent has been expended, even in late years, both upon the working mechanism and the ornamental design of lamps. Of these, the *Carcel*, a curious compound of clockwork and pumps, has been very extensively used; but in the search after simplicity, and consequent cheapness of execution, this complicated plan is being gradually superseded by appli cations of direct spring pressure. Such a contrivance is "Hadrot's Modderator," which has been submitted to our examination by Messrs. Cronin & Co., of Glasgow.

Fig. 4, plate vi. represents a vertical section of the mechanical details of the simplest form of this lamp, as denuded of all ornament. The base of the pedestal contains the oil cylinder A, entirely close at the bottom, and fitted with a piston B, made with a cup-leather packing, somewhat like the packing of a hydrostatic press. The oil is supplied to the cylindrical reservoir in the usual way, by pouring it into the cup C, whence it runs down into the cylinder on the top of the piston. The piston then being elevated by turning the little handle D, the spindle of which carries a pinion gearing with a rack E, fast to the piston; the vacuum beneath the piston causes the oil to pass the sides of the packing, and take up its position beneath, as in the engraving. The elevating power for the oil

* From the Glasgow Practical Mechanic's Journal, No. 36.

is obtained from the helical spring F, formed in four cones, for the purpose of compressing into a small depth. Its upper end abuts against the top of the cylinder, whilst its opposite extremity rests on the piston. When put in action, the piston is wound up to the top of the cylinder, and the downward pressure thus obtained by the reaction of the spring, forces the oil up the tubular piston-rod G. The upper open end of the piston-rod G, enters into the lower open end of a similar fixed tube, fitting accurately to it, so that the oil, in passing upwards, enters this second tube. Two small side openings at H, conduct it thence to the ordinary annular recess I, of the wick. The regulator for the height of wick is at J; its spindle carries a pinion, gearing with a vertical rack in the usual manner. It is, however, in the mode adopted for the adjustment of the oil supply to the burner, at all or any state of the spring pressure, that the improvement for which the inventor claims the name "Moderator" consists. The top of the upper tube, over the tubular piston-rod, is closed in by a screw cap, through which is entered a long spindle K, of small diameter. This spindle passes directly down the centre of the rod, and whilst it permits of a free flow of oil through the tube, its presence, by producing frictional resistance, tends to retard the flow, or restrict it within certain limits. By this contrivance, the higher the piston is elevated, the further does the fixed regulating rod K, penetrate into the tubular rod G; and thus is provided a greater frictional resistance to the flow, just as the greater compression of the spring F, tends to force the fluid up more strongly.

The "Moderator" appears to answer extremely well in preventing an undue overflow at the burner, whilst its simplicity leaves little chance for derangement.

Hydraulic Machinery and Steam Engines. Patented by JAMES THOMSON, *Glasgow.—Enrolled Jan.* 3, 1851.* (*With a plate.*)

The voluminous nature of Mr. Thomson's specification prevents our giving more than a general abstract of its contents. It comprises—First: Improved water-wheels for obtaining motive power from falls of water. Second: A centrifugal pump-regulator for ordinary water-wheels. Third: An apparatus for obviating priming in steam engines, especially in marine engines and locomotives.

The new water-wheels are of two kinds, very distinct from one another, although the class of wheels called *turbines*, when taken in its widest range, includes them both.

The first kind, called by the inventor his Case Wheel, is a turbine in which the movable wheel is enclosed within a fixed case, the water being injected tangentially at the circumference of the case, and then passing through straight or curved radiating conduits in the wheel, and escaping at the centre by two orifices, one of which discharges upwards and the other downwards. Of this machine, one of the most essential features is, that the circumference of the wheel should move with the velocity which a heavy body would attain in falling through a vertical

space equal to half the vertical fall of the water, or, in shorter terms, with the velocity due to half the fall; and that the orifices through which the water is injected into the case should be conjointly of such area, that when all the water required is flowing through them, it also may have a velocity due to half the fall. Thus there is no impact between the water and the wheel; but, on the contrary, the water enters the conduits of the wheel gently, that is to say, with scarcely any motion in relation to their mouths. Since one half only of the fall is employed in producing velocity in the water, the other half still remains acting on the water within the case at the circumference of the wheel in the condition of fluid pressure. Now, with the velocity already assigned to the wheel, it is found that this fluid pressure is exactly that which is requisite to overcome the centrifugal force of the water in the wheel, and to bring the water to a state of rest at its exit, the mechanical work due to both halves of the fall being transferred to the wheel during the combined action of the moving water and the moving wheel. In the foregoing statements, the effects of friction, and of some other modifying influences, are for simplicity left out of consideration; but in the practical application of the principles they must be taken into account, and the manner of doing so is laid down in the detailed explanations and rules given by the patentee.

The second kind of water-wheel is called by the inventor his Suction Wheel, or his improved Danaide.* In this apparatus Mr. Thomson has adopted the principle applied in the French Danaide, and which, admirable as it is, has been left almost dormant since its first promulgation, never having been worked out in a good practical form.

Mr. Thomson's improvements are chiefly as follows:—The total size and the weight of the movable wheel are greatly diminished by his substituting, in the place of the lower part of the tub, a suction-pipe attached to the discharge orifice in the bottom of the tub at the centre. The water is introduced into the movable wheel in a much more advantageous manner than it had been previously, by a peculiar form and position given to the injecting orifices. A self-acting regulator, which is essential to the good performance of the wheel, is supplied in a simple and efficient mechanism. This wheel the inventor considers as being the best that can be used in most cases, when the fall is from about ten to about forty feet, and he regards it, in cases for which it is suitable, as being decidedly superior to the best of the ordinarily used vertical wheels.

Dr. Schinz, Professor of Engineering and the Mechanical Arts in the University of Aargau, some time ago took part in a series of experiments made on this wheel by the inventor. Dr. Schinz has written a very favorable detail of these experiments, which we shall publish next month.

* The name Danaide has been given in France to a particular kind of water-wheel, included in the general class of turbines, and having, as a prominent part of it, a circular vessel, or tub, into which water is constantly poured, and from which it constantly escapes by a hole in the bottom. The name is taken from the Danaides, or the fifty daughters of Danaus, king of Argos, who, all except one, according to ancient mythology, murdered their husbands on the first night of their nuptials, and as a punishment for their crime were, after death, condemned to be constantly filling with water a vessel full of holes, through which the water ran out, so that their toil was endless.

The centrifugal pump-regulator consists chiefly of a large centrifugal pump, driven by some part of the gearing, of which the speed is to be regulated, the connexion of the pump being so arranged that, when the gearing is going at its proper speed, the centrifugal force almost exactly balances the gravity of the water in the pump. This being the case, the pump is kept usually throwing up only a moderate quantity of water; but when, from any cause, the gearing begins to go a little too quickly, the pump raises a much greater quantity, and thus occasions an increased resistance to the motion of the driving-wheel, and *vice versa*. The water elevated is simply allowed to fall back into the reservoir or well, in which the lower end of the pump revolves. If a man be employed to take charge of the driving water-wheel, he should diminish the supply of water to it whenever the centrifugal pump is raising too much water, and he should increase the supply whenever the pump is raising too little. If, however, the supply of water for the driving-wheel be scanty, so that it must be economized, even at the cost of allowing the machinery to go occasionally too slow for a short time, he should keep the pump usually raising no water, but just on the point of raising it. The apparatus will thus be ready to check any excess of speed which may tend to occur. Instead of the man, a self-acting apparatus, such as that already referred to as being adapted by Mr. Thomson to his improved danaide, may be employed to regulate the supply of water to the driving-wheel.

A good apparatus for controlling the speed of large bucket water-wheels has been hitherto a desideratum, because, when the work they have to do is liable to sudden variations, their speed fluctuates to a very prejudicial extent, or, in other words, they are liable sometimes to take "races," and sometimes almost to stop.

The last branch of Mr. Thomson's invention is his apparatus for obviating the bad effects of priming in steam engines. The manner in which the water carried up along with the steam is removed from it, is as follows:—The steam is made to blow into a circular vessel tangentially, at or near the circumference, and passes away from the vessel at the centre. The steam and water in the vessel are thus subjected to a rapid whirling motion, and the water flies outwards by the centrifugal force, and passes off by an aperture or apertures at the circumference. The apparatus may be applied to the engine in various situations, according to convenience, or to the purpose to be served. Thus it may be applied to the steam-pipe either without or within the boiler, and it may be applied at the top, or at any other part of the waste steam-pipe. Figs. 5 and 6, plate vi., represent it as it would be applied to a vertical pipe through which the steam ascends. Fig. 5 is a vertical section, and fig. 6 is a plan in section along the line *a b* in fig. 5. Through the explanation already given, and by reference to the arrows on the figures, it will be seen that the steam is injected into the circular vessel A, tangentially through the orifices B; that, therefore, it must exist in the vessel in a whirling state, and that it passes away by the pipe C, from the centre of the whirl. The water leaves the vessel by the orifices D, at its circumference, and is conveyed by a pipe, E, to any required place. If, for instance, F and C be parts of the steam-pipe leading from the boiler to the cylinder, and the vessel be placed sufficiently high above the level

Fig 1.

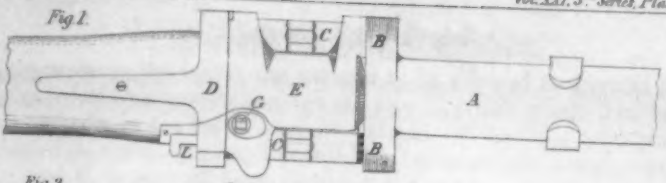


Fig 2.

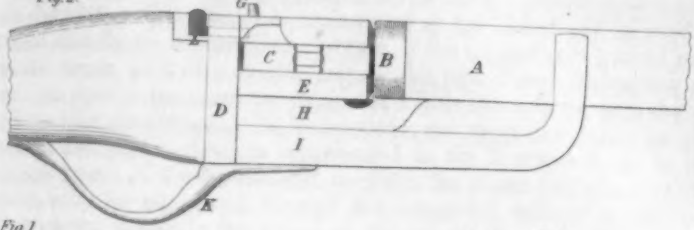


Fig 1.

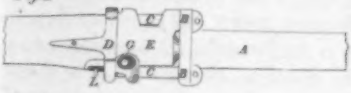


Fig 3.

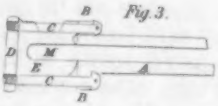


Fig 2.

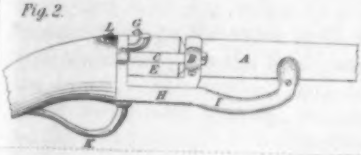


Fig 5.

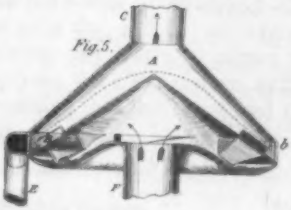


Fig 4.

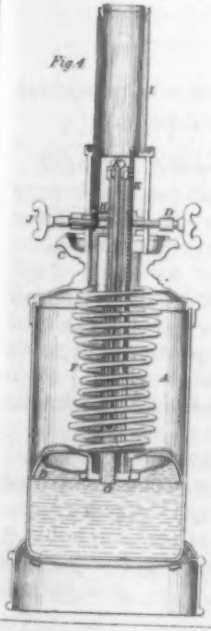


Fig 6.

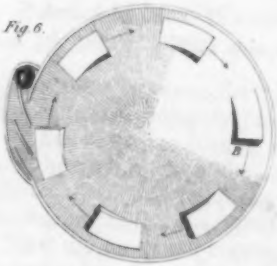
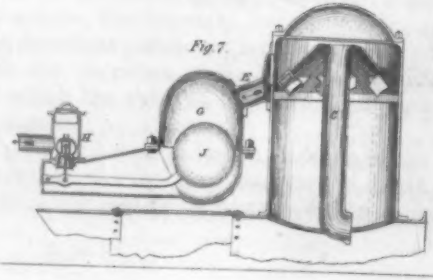


Fig 7.



of the water in the boiler, the water may be allowed to descend into the boiler by its own gravity through the pipe E, which would then be made to terminate in the boiler near its bottom. When this arrangement is adopted, a valve opening towards the boiler may be found requisite in the pipe E, to prevent regurgitation of the water. Another arrangement for disposing of the water is represented in fig. 7, and will be explained when that figure is described. Again, if the apparatus is placed on the waste steam-pipe of a marine engine, the pipe E may convey the water into the paddle-box; and the escape of a little steam along with the water will not be detrimental. In locomotives, the apparatus should be placed within the steam-chest, as represented in fig. 7, where A is an upper compartment of the steam-chest, in which the steam exists in its whirling state, after having passed through the tangential orifices in the conical diaphragm, shown in the figure at the top of the steam-pipe C. The pipe E conveys the water, after it has been separated from the steam, to a close cistern G, from which it is allowed to escape by an equilibrium valve at H, whenever so much of it accumulates as to raise the float J, connected with the valve by a lever and a link. The water, having escaped through the valve at H, may be led either to the tender or to the pipe which supplies the feed-pump, so as in the end to be returned to the boiler. The method also of allowing the water to return to the boiler by its own gravity, without applying the close cistern and float, would be applicable in locomotives, provided that the tangential orifices in the diaphragm be not made too small.

For the Journal of the Franklin Institute.

Description of a Screw Propeller; Patented by JOHN WILLIAM NYSTROM, *Philadelphia, Penna., March* 19, 1850. (*With two plates.*)

Whereas, in Screw Propellers, the water between the blades is acted upon at the same moment by two forces, the one being the propulsive force, resulting from the oblique action of the revolving blades, and the other being the centrifugal force generated by their rotation, the first force tending to force the water backwards in directions parallel to the axis of the propeller, and the second force tending to force it outwards in directions at right angles to the axis. Now my invention consists in counteracting the centrifugal force by the particular curve imparted to the blades of the propeller in such a manner, that the water, instead of being deflected outwards, is delivered in directions parallel with the axis of the propeller.

The formulæ by which the curvature of the blades is calculated, are deduced from those by which the value of the centrifugal force is obtained, in the following manner:

Let a body B (fig. 1, plate VII,) revolve (in the direction of the arrow) round a point A, at a distance of r feet from that central point, with a velocity of h feet per second, its centrifugal force will then be given by the equation,

$$\text{Centrifugal force or } C = \frac{B h^2}{g r}, \qquad (1)$$

in which equation B denotes the weight of the body, and g the force of gravity, or 32·2 feet.

If the number of revolutions per minute, which may be denoted by the letter n, and the radius r, be known, the velocity per second, or the quantity h in equation 1, is found by equation, $h = \frac{2\pi r n}{60}$. (2)

By substituting this value of h in equation (1) we obtain

$$C = B \frac{\frac{4r^2\pi^2n^2}{60^2}}{gr} = \frac{4Br n^2\pi^2}{g60^2}, \quad (3)$$

the value of the centrifugal force in terms of the quantities $Br n\pi$ and g.

Now, referring again to fig. 1, let the line $a\ b$ represent the direction and momentum of the body B, under the action of the propulsive force, and $a\ c$ the magnitude and direction of a force equal and opposite to the centrifugal force acting upon it; then by a well known principle of mechanics, the diagonal ($a\ d$) of the parallelogram erected on the two forces as sides, will represent the magnitude and direction of the resultant force, which will force the body to describe a circle around the centre A, with a radius of r feet, and with a velocity of h feet per second; if then, the blade of the propeller at this distance of r feet from the axis be at right angles to this diagonal line, it will counteract the tendency of the water, which is the body in this instance, to pass outwards from the axis under the action of the centrifugal force.

The angle v, which the blades at this distance from the axis make with the radius, and which is equal to the angle $d\ a\ b$, which the diagonal of the parallelogram makes with the line $a\ b$, is determined by the trigonometrical equation,

$$\text{tang. } v = \frac{\text{sin. } v}{\text{cos. } v},$$

in the parallelogram $a\ b\ c\ d$, $a\ c = \text{sin. } v = C$,

and $a\ b = \text{cos. } v = B$,

hence $\text{tang. } v = \frac{C}{B}$,

and $B \text{ tang. } v = C$.

Substituting in this equation the value of C, given by equation 3, we have

$$B \text{ tang. } v = C = \frac{4Br\pi^2n^2}{g60^2},$$

and

$$\text{tang. } v = \frac{4r\pi^2n^2}{g60^2}.$$

By replacing the symbols π and g by their known value, viz: $g = 32{\cdot}2$ $\pi = 3{\cdot}1416$,

we have $$\text{tang. } v = \frac{4rn^2}{11740} = \frac{2rn^2}{5870}, \text{ (Rule 1,)} \quad (4)$$

which equation represents a rule for finding the angle v, which may be thus expressed in words: Multiply the number of revolutions of the propeller per minute by itself and by the diameter of the circle described in feet; divide the product by 5870; the quotient will be the tangent of the angle which the blades of the propeller should make with the radius at the circumference of the circle described.

If the inclination of the blades at various distances from the axis, be

determined by this rule, and if the inclined lines be united, a spiral curve A D, fig. 1 and 2 (plate VII.) will be formed, progressively increasing in its inclination to the radii of the propeller as it proceeds from the centre to the circumference, and this curve will be contained in the sector of the circle, bounded by two radii, A D and A E, and the included arc D E or W°. In order to save the time required to calculate the inclination of the propeller blade at all the intermediate points between the axis A, and the circumference B, I have recourse to the formula of a parabola, whence an equation is obtained, by which, when the angle of the blade with the radius at the circumference of the propeller is known, the arc W° can be calculated.

In a parabola (fig. 3, plate VII.) of which x is the abscissa, and y the ordinate, at a point D we have

$$\text{tang. } v = \frac{2x}{y},$$

by equation (4) $$\text{tang. } v = \frac{2rn^2}{5870},$$

and by substituting this value of tang. v in the preceding equation,

$$\frac{2x}{y} = \frac{2rn^2}{5870}, \quad \text{and } x = \frac{ryn^2}{5870}. \tag{5}$$

By the formula of the parabola $$x = \frac{y^2}{p}, \tag{6}$$

the parameter $$p = \frac{y^2}{x}; \tag{7}$$

then if y be equal to the the radius r,

$$x = \frac{ryn^2}{5870} = \frac{r^2n^2}{5870},$$

$$p = \frac{y^2}{x} = \frac{r^2}{x} = \frac{r^2}{\left(\frac{r^2n^2}{5870}\right)} = \frac{5870}{n^2},$$

$$x = \frac{y^2}{p} = \frac{r^2}{p} = w^\circ;$$

but in a circle $$r = \frac{180}{\pi},$$

and hence $$w^\circ = \frac{r^2}{p} = \frac{\frac{180}{\pi}}{p} = \frac{180r}{\pi p} = \frac{180r}{\pi\left(\frac{5870}{n^2}\right)} = \frac{180rn^2}{\pi 5870};$$

and by replacing π by its value, we obtain

$$w^\circ = \frac{180rn^2}{18347} = \frac{rn^2}{102{\cdot}4} \qquad \text{(Rule 2.)}$$

which equation represents a rule for determining the angle of the sector of the circle in which the curve of the propeller blade is contained, and which may be thus expressed in words:

Multiply the number of revolutions of the propeller per minute by itself, and by the radius of the propeller in feet. Divide the product by 102·4,

the quotient will be the angle in degrees of the sector in which the curve of the propeller blade is described.

As the curve is a regular spiral, it is described by dividing the angle w° (fig. 2, plate VII,) into a number of equal parts, 6 for example, and numbering them in regular succession from one extremity D, of the arc, to the other, E; then divide the radius E A of the propeller, into the same number of equal parts (6,) and number them in regular succession from the circumference E to the centre A; through the divisions 1 2 3, &c., of the angle w°, draw the radii y' y'' y''', &c., and through the divisions of the radius E A, with the axis A of the propeller as a centre, draw the circular arcs x' x'' x''', &c.; unite the points of intersection of the arcs x' x'' x''', with their respective radii y' y'' y''', &c., by a curved line, which will be the spiral curve required in the propeller blades, moving in the direction indicated by the arrow with n revolutions per minute, to counterbalance the tendency of the water to move outwards from the axis of the propeller, under the influence of the centrifugal force generated by the rotation.

This curve is not influenced by the obliquity of the propeller blade to its axis, or by what is generally termed its *pitch*, which may be adjusted to the power of the engine and to the vessel. As, however, the water is discharged by my propeller in directions parallel with its axis, the slip of the propeller may be less, than with those constructed by the ordinary rules, or the blades straight out from the centre, and consequently increase the speed of the vessel.

This theory for constructing the curve of the blades, or calculating the angle w°, is when the vessel first is to be put in motion; a propeller with the angle w°, calculated after rule 2, would give the greatest effect. But, when the vessel is moving, the angle w° must be less, or proportional to the slip of the propeller; or suppose there was no slip, the curve must be a straight line in the direction of the radius, like a common propeller. But suppose the propeller to be working with n revolutions in a minute, and the vessel not moving, the slip will be equal to the pitch of the propeller, and the angle w° equal to the rule 2.

Suppose the slip to be one-half of the pitch, then when the propeller has moved one turn, it moves the water only half a turn; consequently n in rule 2, will be only $\frac{n}{2}$, or call that $= n'$, and pitch $=$ P, slip $= s$, we have

$$n : n' = \mathrm{P} : s$$

$$n' = \frac{ns}{\mathrm{P}},$$

and from the rule 2, the angle

$$w^\circ = \frac{\pi n^2 s^2}{102\mathrm{P}^2};$$

that is, when P and s are expressed in feet. When s is a fraction of P, we have $n' = ns$

angle $$w^\circ = \frac{\pi n^2 s^2}{102}.$$ (Rule 3.)

This is the practical rule for calculating the angle w°, expressed in words.

Multiply the radius $= r$ by the square of the number of revolutions $= n^2$

that the propeller makes in a minute, and the product by the square of the slip $= s^2$, and divide the last product by 102, the quotient will be the angle w° in degrees.

We see by this (rule 3,) that the angle w° increases with the square of the slip, and for very large propeller vessels, the displacement is very large in proportion to the propeller, the slip is very often one-half of the pitch or more; also, in tow-boats, the slip is very often two-thirds or three fourths; and makes 60 or 70 revolutions in a minute. The angle w° will go to 80° or 90°.

For instance, a tow-boat with a propeller of six feet in diameter, making 70 revolutions per minute, and towing a very large ship, which causes a slip two-thirds, we have the angle

$$w^\circ = \frac{3 \times 70^2 \times (\frac{2}{3})^2}{100} = \frac{3 \times 4900 \times 4}{100 \times 9} = 65^\circ,$$

$$\text{tang. } v = 0{\cdot}035w = 2{\cdot}3 \qquad v = 67^\circ;$$

or in the same instance, let the slip be three-fourths, will be an angle

$$w = \frac{3 \times 4900 \times 9}{100 \times 16} = 81^\circ\ 30'$$

$$v = 70^\circ\ 40^\circ;$$

consequently far from a straight blade or common propeller.

For canal-boats, where it is of importance to prevent, as far as possible, the propeller from agitating the water, that is gained by a propeller constructed with this curve, because it delivers the water as solid as it receives it, which is not the case with the straight blade propeller. There the water is thrown out by the centrifugal force, and causes a partial vacuum behind the centre of the propeller. This vacuum is acting *opposite* the propelling force, and the rudder comes in a porous mass of water, which is not the case with the curve-blade propeller, and the centrifugal force is continually acting *with* the propelling force; and the rudder comes in a solid mass of water, while an easier steering of the vessel is obtained.

For Ocean steamers, or for vessels which have a large displacement in proportion to the propeller, the slip is considerable. For instance, a vessel with a displacement of 1500 tons, its greatest section area about 500 square feet, if the propeller be 13 feet in diameter, the slip will be $= \frac{1}{2}$, if making 60 revolutions per minute, will be an

$$\text{angle } w = \frac{rn^2s^2}{100} = \frac{6{\cdot}5 \times 3600 \times 0{\cdot}25}{100} = 58^\circ\ 40',$$

$$\text{tang. } v = 0{\cdot}035w = 2{\cdot}05 \qquad v = 64^\circ.$$

Another Example. Suppose a U. S. man of war should be changed to a propeller, its displacement being 2000 tons, its greatest section area being 560 square feet, and the propeller 13 feet in diameter; the slip will be 0·54, and making 60 revolutions per minute, will be an

$$\text{angle } w^\circ = \frac{6{\cdot}5 \times 60^2 \times 0{\cdot}54^2}{100} = 68^\circ\ 30',$$

$$\text{tang. } v = 0{\cdot}035 \times 68{\cdot}5 = 2{\cdot}4 \qquad v = 68^\circ.$$

If the pitch of the propeller be 35 feet = P, the speed of the vessel in miles per hour, will be when slip $= s = 0{\cdot}54$

$$\frac{60\text{P}n(1-s)}{5280} = \frac{60 \times 35 \times 60 \times 0{\cdot}46}{5280} = 9{\cdot}8 \text{ miles.}$$

That this propeller is a regular screw, can easily be proved by referring it to an inclined plane, and there lay out the parabola in fig. 3, so that the centre A being one edge, and the screw helix the other edge on the incline plane. I am frequently told that this propeller cannot possibly be a screw, because the blades are curved.

The effect which is gained by counteracting the centrifugal force, will be found by the angle the centrifugal force is acting upon. (I do not mean that I make any new additional effect by the propeller, but, as the steam engine delivers a certain amount of effect to the propeller, it is my intention to construct an instrument that will make use of all this effect in propelling the vessel.)

The accompanying drawing (figs. 4 and 5, plate VIII.) represents a propeller made of wrought iron. The blades are screwed together in the hub, so that any of the blades can be taken off when required. The hub is made of cast or wrought iron, and a round cylinder, to which the blades are screwed. The blades are supported by two bands at the circumference.

Propellers made of cast iron or cast in one piece, will be without bands, and narrower in the hub.

Before entering more fully upon this subject, I must express the wish, that the opinion of scientific men who take an interest in this matter, could be obtained.

Philadelphia, April, 1851.

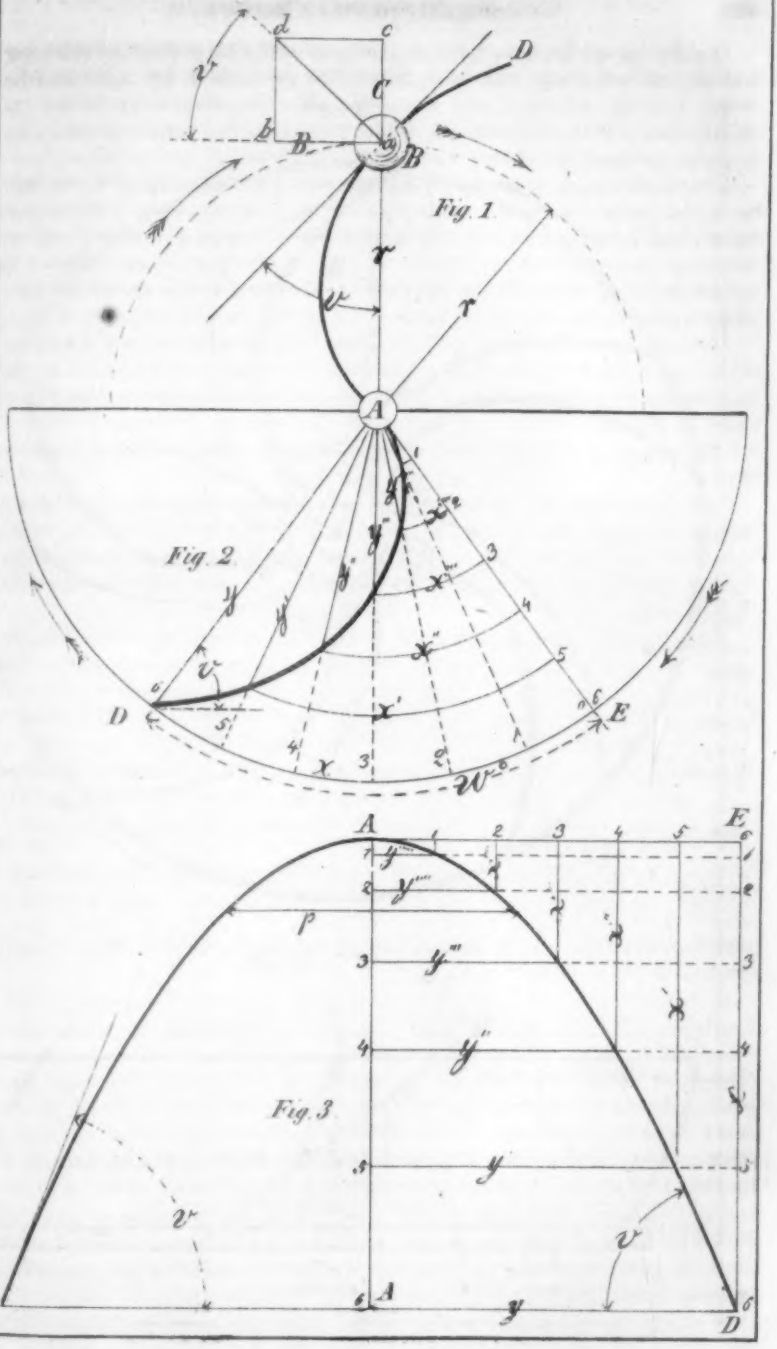
Translated for the Journal of the Franklin Institute.

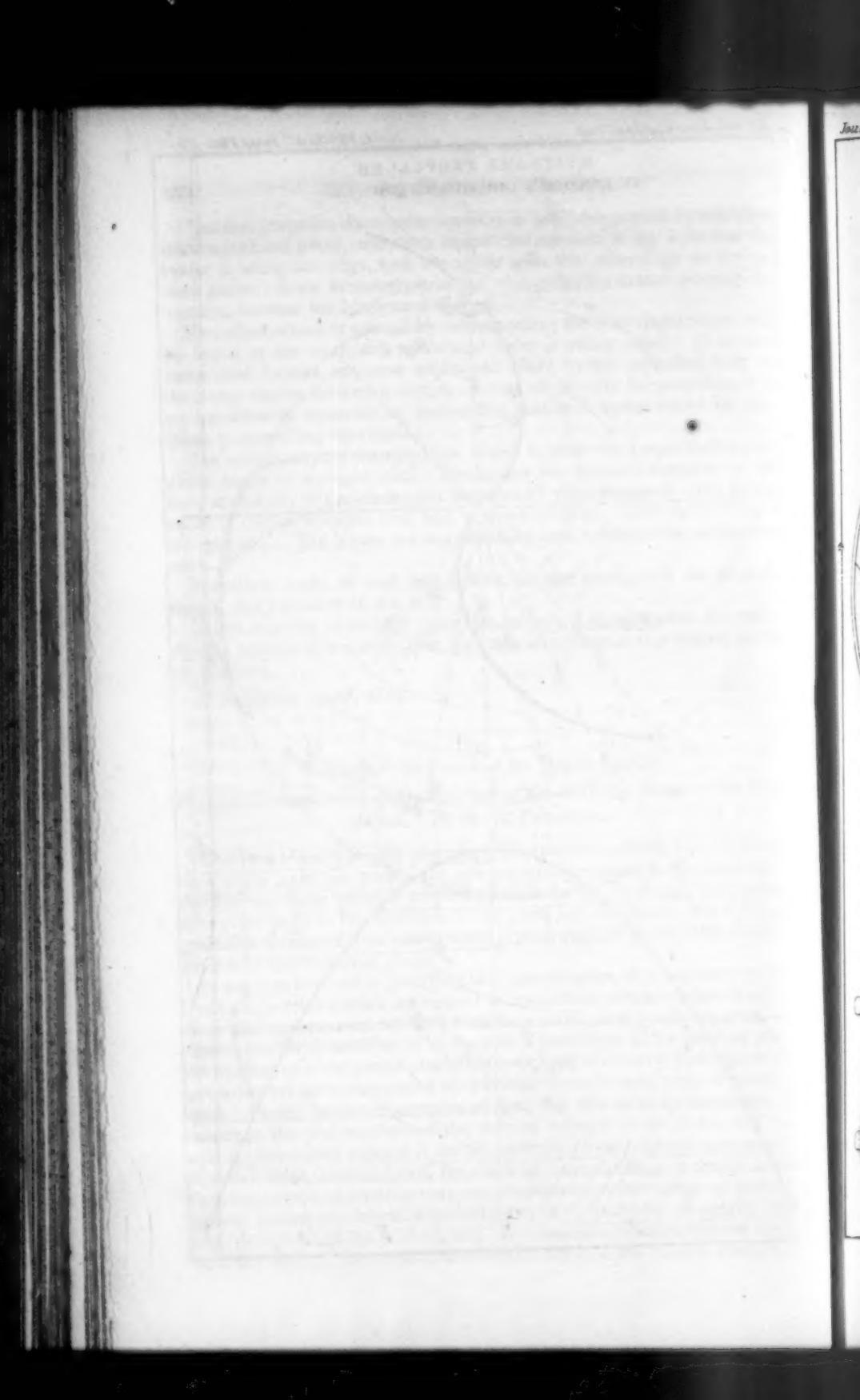
Physical Demonstration of the Rotation of the Earth by Means of the Pendulum. *By* M. L. FOUCAULT.

The very numerous and important observations which have hitherto been made upon the pendulum, are especially relative to the time of its oscillations; those which I propose to relate to the Academy, have reference principally to the direction of the plane of oscillation, which being gradually displaced from east to west, gives a sensible proof of the diurnal motion of the terrestrial globe.

In order to succeed in justifying this interpretation of a constant result, I will neglect the earth's movement of translation, which is without effect upon the phenomenon which I wish to exhibit, and I will suppose the observer to have established at the pole a pendulum of the greatest simplicity: that is, a compound pendulum composed of a heavy, homogeneous, and spherical mass, suspended by a flexible thread from a point absolutely fixed. I will, moreover, suppose at first, that this point of suspension is exactly in the prolongation of the axis of rotation of the globe, and the solid masses which support it do not participate in the diurnal movement. If, under these circumstances, the mass of the pendulum is drawn aside from its position of equilibrium, and abandoned to the action of gravity without having any lateral impulse given to it, its centre of gravity will pass again through the vertical, and by its acquired velocity will rise upon the other side of the vertical to a height nearly equal to that whence it

NYSTROM'S PROPELLER.





NYSTROM'S PROPELLER.

Fig 4

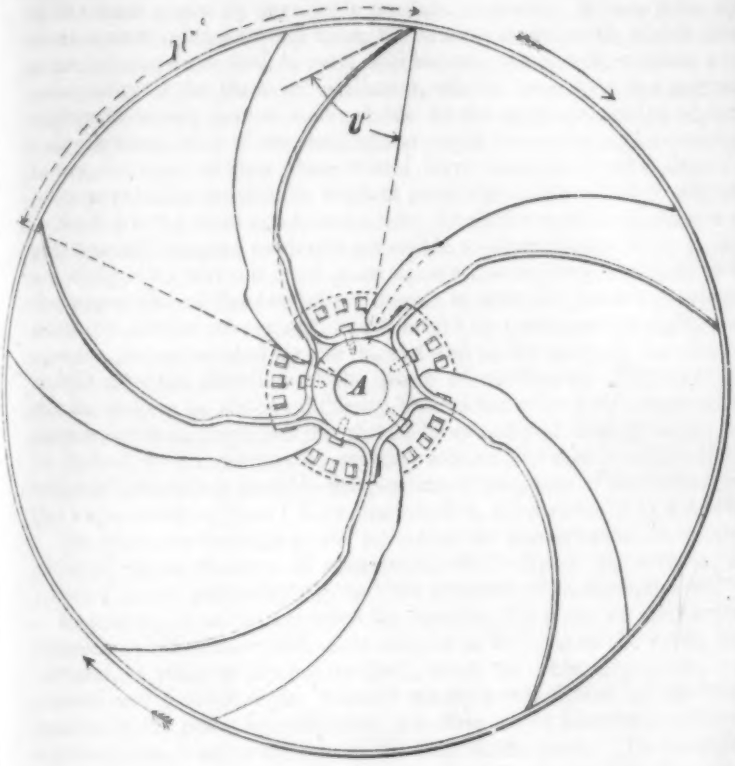
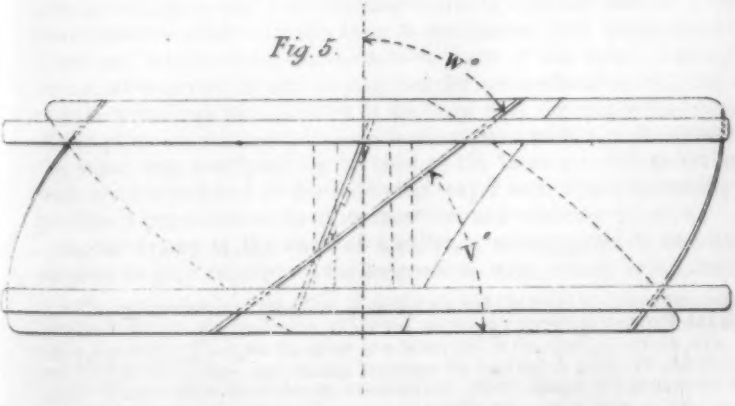


Fig. 5.



came. Arrived at this point, its velocity dies out, changes its sign, and brings it back, causing it to pass again through the vertical to a point a little below its starting point. Thus a movement of oscillation is excited in an arc of a circle whose plane is clearly determined, to which the inertia of the mass gives an invariable position in space. If then these oscillations continue for a certain time, the motion of the earth, which does not cease turning from west to east, will become sensible by contrast with the immobility of the plane of oscillation, whose trace upon the ground will appear to have a motion conformable to the apparent motion of the heavenly sphere; and if the oscillations could be continued for twenty-four hours, the trace of their plane would have executed in that time a complete revolution around the vertical projection of the point of suspension.

Such are the ideal conditions under which the motion of rotation of the globe would become evidently accessible to observation. But, in fact, we are obliged to take our fixed point upon a moving base; the parts to which the upper end of the pendulum thread is attached cannot be withdrawn from the diurnal movement, and it might be feared, at first sight, that this motion, communicated to the thread and to the mass of the pendulum, would alter the direction of the plane of oscillation. However, theory shews us here no serious difficulty, and on the other hand, experiment has shewn me that, provided the thread be round and homogeneous, it may be turned with considerable rapidity around its axis in either direction, without influencing sensibly the position of the plane of oscillation, so that the experiment such as I have described it, must succeed at the pole.*

But when we descend to our latitudes, the phenomenon becomes complicated by an element of considerable difficulty of appreciation, and to which I desire particularly to call the attention of mathematicians.

In proportion as we approach the equator, the plane of the horizon assumes a position more and more oblique to the axis of the earth, and the vertical, in place of turning on itself, as at the pole, describes a cone of greater and greater angle; whence results a retardation in the apparent motion of the plane of oscillation, a motion which becomes nothing at the equator, and changes its sign in the other hemisphere. To determine the law according to which this motion varies in different latitudes, we must have recourse either to analysis or to mechanical and geometrical considerations, which do not suit the narrow limits of this note. I must, therefore, confine myself to announcing that the two methods accord (neglecting certain secondary phenomena) in shewing that the angular displacement of the plane of oscillation is equal to the angular motion of the earth during the same time multiplied by the sine of the latitude. I then set to work with confidence, and in the following way I established the reality of the predicted phenomenon as to its direction and probable amount.

At the crown of the vault of a cellar, a strong piece of cast iron was secured to give support to the suspension wire, which hung freely from

* The independence of the plane of oscillation and the point of suspension, may be rendered evident by an experiment which led me to my investigations, and which is very easily repeated. Fix upon the arbor of a lathe, and in the direction of the axis, a round and flexible rod of steel, and cause it to vibrate by drawing it aside and abandoning it to itself. Thus a plane of oscillation is determined, which, owing to the persistance of visual impressions, is clearly defined in space; now it will be remarked, that on turning with the hand the arbor which supports this vibrating rod, the plane of oscillation is not displaced.

a small piece of tempered steel, whose free surface was perfectly horizontal. This wire was of steel, strongly compressed by the action of the drawing-plate; its diameter varied from $\frac{6}{10}$ to $\frac{1}{10}$ of a millimetre; it was two metres long (78·75 inches,) and carried at its lower end a ground and polished sphere of brass, whose centre of gravity had been made to coincide with its centre of figure. This sphere weighed five kilogrammes (10 lbs.) and carried a sharp projection, which appeared to be a continuation of the suspension wire. When it was desired to try an experiment, we began by destroying the torsion of the wire, and stopping the turning of the sphere. Then to draw it aside from its position of equilibrium, it was included in a loop of organic thread, whose free extremity was attached to a fixed point in the wall at a small height above the ground. The length of oscillation of the pendulum was determined by the length given to the thread; generally in my experiments these oscillations were at first from 15° to 20°. Before proceding it is necessary to destroy, by an obstacle gradually withdrawn, the oscillating motion which the pendulum has in its restraint by the two threads. Then when we have succeeded in bringing it to rest, the organic thread is burned at some point of its length; its tenacity then ceasing, it breaks, the loop falls to the ground, and the pendulum obeying gravity alone, begins to move, and gives a long series of oscillations, whose plane quickly experiences a sensible displacement. At the end of a half hour, this displacement is such that it is evident to the eye; but it is more interesting to follow the phenomenon more closely, so as to be satisfied of the continuousness of the effect. For this purpose a vertical point or style is made use of, mounted on a support and placed on the ground, so that in its swinging motion the projection from the pendulum, at the limit of its excursion, will just touch the fixed point. In less than a minute, the exact coincidence of the two points ceases to be reproduced, the oscillating point being displaced constantly towards the left of the observer; which indicates that the direction of the plane of oscillation takes place in the same direction as the horizontal component of the apparent motion of the celestial sphere. The mean value of this motion for any time, shews conformably to the indications of the theory, that in our latitude the horizontal trace of the plane of oscillation does not make a complete revolution in twenty-four hours.

I owe to the kindness of M. Arago, and the intelligent zeal of our skilful instrument maker, M. Froment, who actively assisted me in the execution of this work, the means of being able already to reproduce the experiment on a larger scale. Profiting by the height of the *Salle de la Meridienne*, at the Observatory, I have been able to give my pendulum a length of 11 metres, (36 feet.) The oscillations became more slow and larger, so that between two consecutive returns of the pendulum to the fixed mark, a deviation to the left was very manifest. *

In conclusion I will present one further remark:

It is, that the facts observed under these circumstances, accord perfectly

* Since then it appears by the papers that Mr. Foucault has established his interesting and curious experiment in the dome of the Pantheon, where his pendulum has a length of 65 metres (213 feet). The result will of course be still more manifest at each rotation. —Ed. Fa. Jr.

with the results announced by Poisson in a very remarkable memoir, read by him before the Academy, 13th November, 1837. In this memoir, Poisson, treating of the motion of projectiles in the air, and taking into consideration the diurnal movement of the earth shows, by calculation that in our latitude, projectiles thrown towards any point, experience a deviation which takes place constantly towards the right of the observer, standing at the point of departure and looking towards the trajectory. It appears to me that the mass of the pendulum may be compared to the projectile, which deviates towards the right while departing from the observer, and necessarily in the opposite direction in returning towards its point of departure; which leads to the progressive displacement of the mean plane of oscillation, and indicates its direction. But the pendulum possesses the advantage of accumulating the effects, and allowing them to pass from the domain of theory into that of observation.—*Comptes Rendus de l'Acad. de Sciences de Paris.* 3 *Fevrier*, 1851.

For the Journal of the Franklin Institute.

Sectional Dry Dock.

Messrs. Simpson & Niel have recently put in operation, at the foot of Christian Street, four sections of this valuable dock. Each section is 72 feet long, 27 feet wide, and 8 feet deep, and has a lifting power of 350 tons; at the end of each section is a float, which may be depressed or elevated in the water at pleasure. These floats maintain the perfect equilibrium of the sections; the water from each section is pumped out by six pumps of 11 inches diameter and 11½ inches stroke, which take out fifteen tons of water per minute, and, of course, elevate that amount of weight in the same time; this is the maximum effect practically. They have lifted a vessel of 250 tons in twenty minutes. For working the pumps, and elevating and depressing the floats, they have two high pressure beam engines, with cylinders of 10 inches diameter and 2 feet stroke, which, with all the connecting machinery, is from the establishment of Merrick & Son. The value of this improvement to the commerce of Philadelphia may be appreciated, when it is known that all our large vessels have been compelled to repair at other ports. Messrs S. & N. intend soon to add another section, when they will be able to take out any vessel now trading to this port. B.

For the Journal of the Franklin Institute.

Cornish Engines.

It is about two years since the first Cornish engine was imported into this country, and put in operation at the copper mine at Perkiomen. The engine brought over was one that had been used in Cornwall, but still perfect in all its parts. The success attending it has caused several to be constructed in this country; and Messrs. J. T. Sutton & Co., of this city, are building one, having a cylinder of 50 inches diameter and 10 feet stroke, to be used near the one first alluded to; and I. P. Morris & Co. are building two of the same size, for supplying the city of Buffalo with

water. The great economy of these engines will no doubt lead to their further introduction for the purpose of elevating water, to which they are peculiarly adapted. B.

For the Journal of the Franklin Institute.

New York Steamers.

The steamer Carribbean left New York on her first trip to Chagres on the 18th March. Her dimensions are 240 feet long on deck, 31½ feet beam, 22 feet hold; with two river beam engines, cylinders 50 inches diameter, 10 feet stroke, from the establishment of Messrs. Cunningham, Belknap & Co. They are the first engines for marine purposes finished by them, and do them credit. On her trial trip she maintained a speed of 16 miles per hour.

The steamer Brother Jonathan left New York on the 17th March, on her first trip for Chagres. Her dimensions are as follows: length on deck 230 feet, breadth of beam 36 feet, depth of hold 21 feet, floor beams 14 inches deep; frame of live oak, white oak, locust, and cedar, secured by diagonal braces of flat bar iron 5 feet apart, 4½ inches wide × ¾, and extending from stem to stern. Her engine is of the river beam kind, built by the Morgan Iron Works; cylinder of 72 inches diameter, 11 feet stroke; paddle-wheels 33 feet diameter, 9 feet face, and paddles 30 inches deep; two boilers of 12 feet diameter of shell, and 28 feet long. B.

For the Journal of the Franklin Institute.

Morse's Magnetic Telegraph.

If the Editor of the Practical Mechanic's Journal, has found out yet who invented Parker's Water-wheel—will he be good enough to correct the very unfair statement on the 8th page of his number for April, where Morse is stated to have introduced his Telegraph in 1847, in place of September, 1837, which is the date of his caveat. In February, 1838, he exhibited his experiment before the Franklin Institute, and in September of the same year, he communicated it to the Academy of Science, at Paris. The line from Baltimore to Washington, was at work in 1844.

Fiat Justitia, Mr. Editor, if the Yankees do get ahead sometimes.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 17, 1851.

S. V. Merrick, President, in the chair.
John Agnew, Vice President.
John F. Frazer, Treasurer. } Present.
Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from Hon. Joseph R. Chandler, U. S. Congress; the Young Men's Mercantile Library Association, Cincinnati,

Ohio; Peleg B. Savery, Pennsylvania Senate; Charles E. Smith, Esq.; and Professor J. C. Cresson, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's report of the receipts and payments for the month of February was read, and also a statement of the receipts from the pupils of the Drawing School of the Institute.

The Board of Managers and the Standing Committees reported their minutes.

The Board of Managers reported that Messrs. Robert Lindsay and John C. Copper had resigned their seats in the Board, and that Messrs. M. W. Baldwin and John H. Towne had been elected to fill the vacancies.

The Committee on Exhibitions reported that they had elected Professor J. C. Cresson their Chairman for the ensuing year.

Candidates for membership in the Institute (6) were proposed, and those proposed at the last meeting (8) were duly elected.

Dr. Rand, Chairman of the Committee of Meetings, exhibited the burner of M. Gaillard, of Paris, intended for rendering hydrogen gas available for illuminating purposes. It consists of an ordinary argand burner, attached to which, on the inner side of the orifices by which the gas is emitted, is placed a cylinder of gauze, made of fine platinum wire, which, becoming intensely heated by the burning hydrogen, gives out, according to the published statements, a beautifully soft, steady light. He had not succeeded in producing such a light, but was not prepared to give an opinion as to the merits of the invention, as it had not, as yet, been subjected to the test of thorough experiment. The burner was tried before the members, but without very satisfactory results.

Mr. Bishop remarked that this plan was much used in France for heating purposes.

Prof. Frazer stated that he had received, in a private letter from a friend in Paris, who had witnessed an exhibition of this mode of lighting and warming, the following account of it:

"They make their gas from water by producing steam in the usual way, which is carried by a tube into an adjoining chamber, and issues, by means of capillary holes, on to a bed of charcoal at a white heat, (the tube is forked in the chamber to give more points of issue;) here the decomposition takes place, and the hydrogen and carbonic acid gas pass together into a second chamber, where a bed of lime and hay absorb the carbonic acid gas, leaving the pure hydrogen to pass into a gasometer of the usual form. I was informed that they produced 1000 cubic feet (French) of hydrogen gas, with 200 kilos. of coke. They propose economizing fuel by making the steam and heating the charcoal by the same fire, using the waste heat to burn his lime over again. The gas is carried into the apartments by pipes, and the burners are placed in the most convenient positions. The burners are circular; the gas issuing perpendicularly from a ring (of about an inch in diameter,) of small holes, and burning with a pale blue flame, having in itself very little lighting power; but just inside of the ring, so as to be in contact with the flame, is a

circular wick, about 1½ inches in height, of platina wire, woven into network; this heats immediately, and gives out a beautiful pale red light, much more agreeable to the eye than our gas; very steady, without any wavering, and equal (according tot heir estimate by the photometer,) to 15 bougies de l'etoile, which are about the same as our best sperm candles. This light appears to produce no change in color, and we distinguished different shades of blue, green, yellow, &c., without any difficulty. When we saw the experiment there was but little pressure of gas on, and I did not estimate the light at more than 8 or 10 candles by the eye; but I have no reason to doubt the correctness of their statement under favorable circumstances. Eight burners illuminated the room most magnificently, and the light was a most agreeable one—no current of air would put it out; we tried with a large pair of bellows, the top of the wick blackened whilst we blew on it, but the instant the blast ceased, it was all alight again.

"The heating apparatus consisted of a horizontal hollow bar, connected in the middle with the gas-pipe and closed at each end. The gas burnt as it issued from a line of holes, larger than those in the other burners, and about half an inch apart. The room, which was about 16 feet square, with a brick floor, and most unpleasantly cold when we came into it, was heated in less than five minutes, so that we were glad to open the doors for a little cool air. With this there will be no need of chimneys, for there is no smoke nor the least unpleasant smell, and the heat is moist—very different in that respect from the dry heat produced from our anthracite fires. The only cooking utensil they showed us was a gridiron of hollow copper bars, the handle of which (also hollow,) was screwed on to an India rubber tube connected with the gas-pipe; the flame issuing from lines of holes in the bars, did the cooking on an ordinary iron gridiron placed above it. The great improvement appears to be the use of the platina wick for lighting; it appears to be inconsumable, or nearly so, for those which had been in use for three months were perfectly bright, and appeared to be unchanged. I was informed that the cost of this system of lighting, heating, &c., is an enormous economy on the old plan."

Prof. Frazer exhibited to the members a copy of the geological map of France. Besides the great value attaching to this map on account of the great minuteness and accuracy of the examinations upon which it was founded, he stated that his special reason for bringing it to the notice of the members of the Institute was, the perfection of its mechanical execution. It is printed in colors, of which there are twenty-three, none of which are formed by the superposition of two others, but each obtained by a separate impression. In many cases these colors run in long, narrow, and very sinuous bands, and the boundaries of the respective formations are marked by dotted lines. In no part of the map can a place be found in which two colors overlap each other, or fall short by the breadth of the boundary line. The transparency of the tints and the general harmony of the whole coloring were also very remarkable. The processes by which this almost incredible accuracy had been attained, were briefly described by Prof. F., and he referred his hearers for a more minute account of them to the report of Mr. Dumas on the subject, in

the *Comptes Rendus de l'Academié des Sciences de Paris, vol.* XXII., *p.* 929. 8 *Juin*, 1846.

Dr. Rand also exhibited a sheet of gutta percha tissue, made by Mr. John Thornley, which had been very advantageously substituted for oiled silk, in many cases where the latter had been formerly much in use. It was more particularly valuable in surgical dressings, being more cleanly than oiled silk, and not likely to blacken from the contact of putrescent discharges, as was the case with that substance, owing to the lead used in its preparation.

Dr. Turnbull observed that, while on the subject of gutta percha, he would make the following remarks upon its insulating properties:

According to Matteucci, the insulating property of dry gases diminishes perceptibly even within the interval of temperature from 10° to +20°. Shellac and sulphur likewise commence to conduct electricity even at 25°—30°. Riess has remarked that shellac sticks, freshly prepared, retain electricity much better than after a few days. This results from the agency of the atmosphere on the surface of the shellac. The use of the sticks, their repeated exposure to the point of the spirit-flame—to make them non-electric—also tends to hasten the deterioration. Such sticks as have become unfit for use, may be restored perfectly to their original state by washing with alcohol. Until lately, we were almost exclusively restricted to the use of shellac for efficient insulation; as glass, or even silk, very easily become conductive by reason of their property of attracting moisture from the air. In 1848, Prof. Faraday drew the attention of physicists to the highly insulating and electric power of gutta percha, which not only possesses this property under ordinary circumstances, but likewise retains it under atmospheric conditions, which would make the surface of glass a good conductor.

A good piece of gutta percha insulates as perfectly as shellac, whether it be in the form of a disk, a stick, or a thread; it is, moreover, tough, a slip one-eighth of an inch sustaining 42 lbs. It is also pliable over the temperature of 50°, soft in the heat, and hence preferable in many cases to brittle shellac. In the form of straps or cords, gutta percha presents an excellent means of suspension, and in plates it furnishes the best insulating supports. It forms excellent insulating stoppers for the ends of gold-leaf electrometers inclosed in tubes; larger stoppers furnish good insulating stuffing for temporary electrical arrangements. This good insulation, moreover, fits it admirably for exciting negative electricity.

All the gutta percha of commerce does not insulate equally well. If, however, a conducting piece be warmed in a current of hot air, or in a glass over a spirit-lamp, then spread out and kneaded for some time between the fingers, as though the moisture it contains were to be pressed out, as good an insulator as possible is obtained. A degree of insulation, no less than that of gutta percha, is possessed by collodion,—the residuary substance obtained by the evaporation of an etheral solution of gun cotton. If the clear solution be spread over a glass plate, there remains, after volatilization of the solvent, a transparent cuticle, which, by merely passing the hand over it, or more effectually by friction with wool, become negatively electric, and obstinately retains this electrical state.

Mr. Cooke exhibited a machine for rending apart street gas or water mains, being a compact contrivance for accumulating power by means

of a series of connected wheels. It was intended to be employed in any case in which it was desirable to use a great force in a small space. He also exhibited a convenient lantern for lighting gas lamps by means of a perforation in its lower surface; the gas was admitted to the wick of the small lamp contained within it, and the gas burner thus ignited. Its object was to obviate the danger of carrying fire about in order to light the gas, as well as to prevent the burners becoming choked by small portions of the match, with which they are lighted, getting into them.

Obituary Notice.

We are called upon to perform the painful duty of recording the recent deaths of two distinguished men, who have been among the foremost in those brilliant investigations which have characterized our century, and while they so largely expanded our comprehension of the laws of nature, have equally promoted the practical arts. These individuals are Prof. Œrsted, of Copenhagen, and Prof. Jacobi, of Berlin. Both have been distinguished not more for the acuteness of their perceptions and the laborious accuracy of their researches, than for the practical application of their results, and their importance to society; both of them will be deeply regretted, not only by the friends whom their private virtues had gathered around them, but by the lovers of science in all quarters of the globe, who had been accustomed to appreciate their constant and valuable contributions to knowledge.

Œrsted is best known in this country by his discovery of the reaction between the galvanic current and the magnetic needle, published by him in 1820, upon which is built the now immense and important science of electro-magnetism, which, amongst other benefits, has given us the electric telegraph. He is also the inventor of the beautiful instrument for the measurement of the compressibility of liquids, the principle of which has found so many useful applications in the arts. We mention these as perhaps the most practical of his labors; but we should not have space enough for a mere enumeration of his important scientific labors; when we state that he was made a foreign member of the Royal Society of Great Britain in 1821, and in 1842 elected one of the eight *academiciens libres* of the French Academy of Sciences, the highest distinction to which a man of science can attain, our readers will understand in what appreciation he was held by the scientific nations of Europe. His last work was published in Copenhagen in 1850, and entitled "The Spirit in Nature: being a popular contribution towards illustrating the spiritual influences of nature." He was, in the words of one who knew him well, "loved and esteemed by every one who knew him. Men of the highest rank were happy to associate with him, and held it an honor to be admitted to his family circle. He was learned, of the highest morality and honor, and the best spouse and father." He was honored by the science-loving King of Denmark by all the marks of confidence and respect which he could bestow upon him; and died in the enjoyment of all the comforts which a well-spent life could give to him, on the 9th of March, at the age of 74.

Prof. Jacobi, though less popularly known perhaps, is not less celebrated as a natural philosopher, but has devoted himself more to the mathematical investigation of phenomena, although his experimental results are neither few nor unimportant. Among them we may rank his discovery of the galvano-plastic process for copying medals, &c., by electricity, discovered about the same time by Draper; and his very valuable examination into the best methods of laying telegraphic wires, for the purpose of avoiding disturbances from the charges of atmospheric electricity. Jacobi was a native of Prussia, but was much employed by the Russian government, and many of his most valuable papers are to be found in the Transactions of the Academy of St. Petersburg. F.

BIBLIOGRAPHICAL NOTICE.

Report of the Superintendent of the United States Coast Survey, showing the progress of the work for the year ending November, 1850.

The annual report of the Superintendent of the Coast Survey again brings under our immediate notice the progress of this great national work, and requires from us again the tribute of our admiration of the manner in which it is conducted and the results which have been obtained.

We have had occasion so often to call the attention of our readers to the objects of this survey, and the general mode by which these objects are to be obtained, that it cannot be necessary for us to say any thing upon these subjects at present; nor could it be possible for us to convey to the mind of any one, not conversant with labors of this kind, any idea of the comparative merit of this one. We have before stated that the great features of Prof. Bache's plan of conducting his work, were the union of great rapidity of work with the greatest accuracy of which observation and calculation are capable; the attainment of these ends, with increased economy of expenditure, and the rendering available every discovery of practical importance by its immediate publication and circulation among the persons whom its knowledge might benefit. In seeking the accomplishment of these ends, the Superintendent has immensely multiplied his own labor and anxieties, and incurred additional responsibilities, from which most men would shrink. The commencement of such a work as a great geodetic survey, at a number of points simultaneously, by the measurement of different bases, and the extension of the triangulation from them until the separate parts meet each other, is a pledge that all the means of accuracy, which science has hitherto made available, will be put in requisition in its conduct.

It would be scarcely necessary for us to say this much at this late day on the subject of the Coast Survey, were it not that we saw, we need not say with what feelings of mortification and regret, an endeavor made in one branch of Congress, during the last session, to alter the plan of conducting the work, and to place it under the control of the Navy Department. We were glad to find the project abortive, and the evils and